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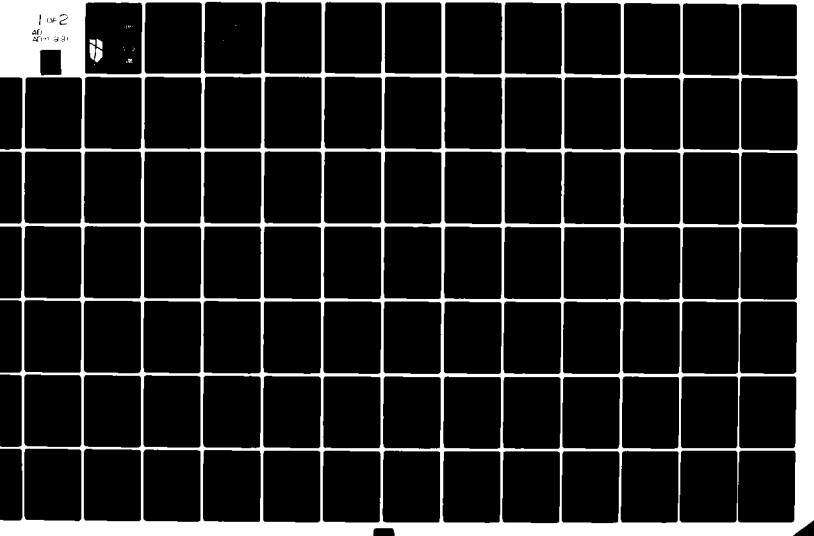

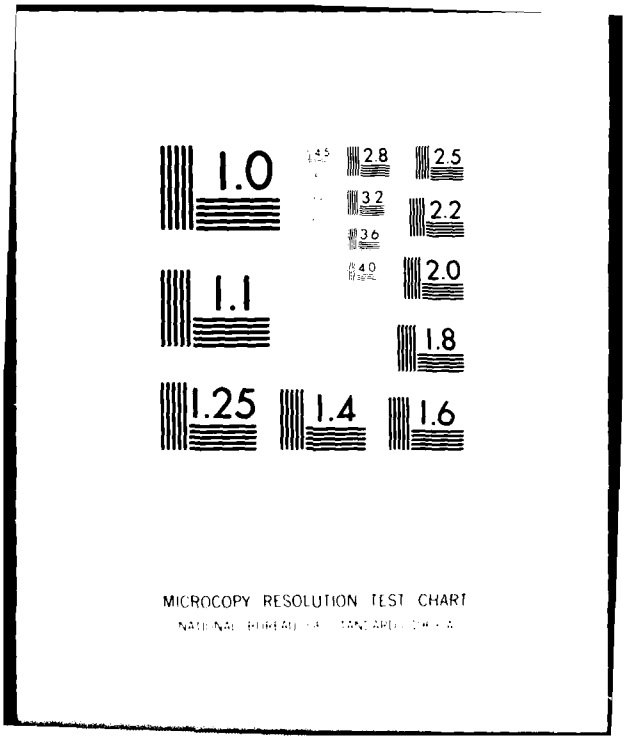
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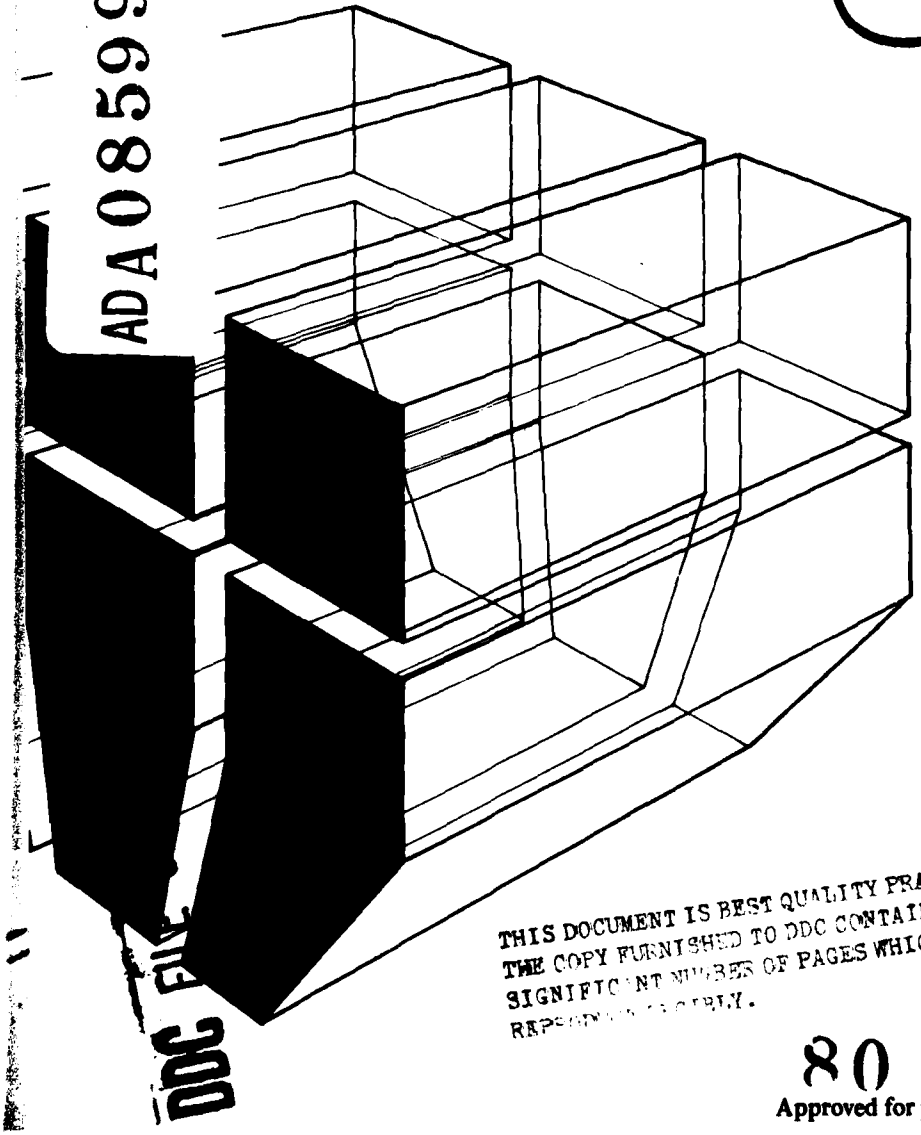
TECHNICAL REPORT N-87
May 1980

INTERAGENCY/INTERGOVERNMENTAL COORDINATION FOR ENVIRONMENTAL PLANNING (IICEP): SYSTEMS CONSIDERATIONS

(12) LEVEL II



by
R.D. Webster
D.E. Putnam

CERL

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The primary purpose of this report is to document the organization and command structure of a computerized system for providing access to information necessary for the Interagency/Intergovernmental Coordination for Environmental Planning (IICEP) requirements as set forth in Air Force Environmental Planning Bulletin 14. A secondary objective is to identify problems associated with the IICEP system's implementation and to recommend pertinent solutions. Preliminary data acquired

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by Air Force contractors were obtained and used as a basis for developing the software structure necessary to handle these data. This report describes IICEP and explains the development of the organization, structure, and software of the pilot computerized system. It will form the basis for evaluating the system and further clarifying the need for data base refinement and update.

FOREWORD

This project was performed for the Department of the Air Force Engineering and Services Center (AFESC), Tyndall AFB, FL, under Project Order Number S-79-26 dated 19 March 1979. CPT R. Hawkins was the project monitor.

The work was performed by the Environmental Division (EN), U.S. Army Construction Engineering Research Laboratory (CERL), Champaign, IL.

This research was made possible through the efforts of Air Force personnel and the scientists and engineers of CERL. Administrative support and counsel were provided by Dr. E.W. Novak, Acting Chief of EN.

COL L.J. Circeo is Commander and Director of CERL, and Dr. L.R. Shaffer is Technical Director.

CONTENTS

INTERAGENCY/INTERGOVERNMENTAL COORDINATION FOR ENVIRONMENTAL PLANNING (IICEP): SYSTEMS CONSIDERATIONS

1 INTRODUCTION

Background

The U.S. Army Construction Engineering Research Laboratory (CERL) has maintained an extensive systems development program for Department of Defense (DOD) personnel to use in environmental assessment, planning, and management. These systems include the Environmental Technical Information System (ETIS) and its subsystems[1]—the Environmental Impact Computer System (EICS),[2] the Economic Impact Forecast System (EIFS),[3] and the Computer-Aided Environmental Legislative Data system (CELDS).[4] These systems have been used extensively by both the Army and the Air Force. As a result of this cooperative effort, CERL has been tasked with analyzing new areas for assisting users and producing other systems which respond to these additional requirements and also function in the same interactive mode as ETIS. This mode is extremely beneficial from both developmental and operational standpoints.[5] For instance, one new application for the ETIS type of system has been the review and systemization of the Air Force's three-volume directory—Interagency/Intergovernmental Coordination for Environmental Planning (IICEP)—developed to insure adequate coordination of Air Force activities with state and local agencies responsible for environmental planning issues as required by Air Force Interim Planning Bulletin 14. Updating the information in the current directory is a problem. Responsibilities of the listed agencies change constantly; furthermore, the directory—filling three large binders—is physically awkward and inconvenient to update because changes must be mailed to all users. A computerized system could help remedy these difficulties. Implementation of IICEP as a new subsystem of ETIS will encourage maintenance of current directories by simplifying retrieval of the contacts.

Objective

The primary purpose of this research was to develop a pilot IICEP computerized system operating in interactive mode on the same host computer as ETIS and exhibiting the same user-oriented characteristics as the other ETIS subsystems. A secondary objective was to identify any problems associated with the IICEP system's implementation under ETIS and to recommend solutions to these problems.

Approach

The documentation for IICEP was obtained from AFESC, the data base was designed and developed, and an interactive retrieval program was designed and implemented.

2 THE IICEP PROGRAM

IICEP includes a three-volume directory of state environmental planning agencies designed for use by the three Air Force Regional Civil Engineers. Agencies located in all 50 states, Guam, and Puerto Rico are included. The listed agencies deal with issues from the following environmental categories:

1. General
2. Air Resources
3. Energy
4. Health and Safety
5. Land Use
6. Natural Resources
7. Noise
8. Socioeconomics
9. Solid Waste
10. Transportation
11. Water

Table 1 gives the subdivisions of the 11 major environmental categories.

[1]R.D. Webster, et al., *Development of the Environmental Technical Information System*, Interim Report E-52/ADA009668 (U.S. Army Construction Engineering Research Laboratory [CERL], April 1975).

[2]Robert Baran and R.D. Webster, *Interactive Environmental Impact Computer System (EICS) User Manual*, Technical Report N-80/ADA074890 (CERL, September 1979).

[3]R.D. Webster, L. Ortiz, R. Mitchell, and W. Hamilton, *Development of the Economic Impact Forecast System (EIFS)—The Multiplier Aspects*, Technical Report N-35/ADA057936 (CERL, May 1978); J.W. Hamilton and R.D. Webster, *Economic Impact Forecast System, Version 2.0: User's Manual*, Technical Report N-69/ADA073667 (CERL, July 1979).

[4]R.L. Welsh, *User Manual for the Computer-Aided Environmental Legislative Data System*, Technical Report E-78/ADA019018 (CERL, November 1975); J. van Weringh, J. Patzer, R. Welsh, and R. Webster, *Computer-Aided Environmental Legislative Data System (CELDS) User Manual*, Technical Report N-56/ADA061126 (CERL, September 1978).

[5]B.W. Kernighan and J.R. Mashey, "Unix Programming Environment," *Software Practice and Environment*, Vol 9, No. 1 (January 1979), pp 1-15; J. Zucker, K.H. Davis, and P.J. Plauger, *Automated Software Design Tools:* "Unix: A High Level Environment for the Development of Microprocessor-Based Systems," "Using Unix for Development of Microprocessor-Based Systems," "Using Unix for Developing Microprocessor Software: A Case Study," "Unix in an Office Environment": presented at Midcon 77 Electronic Show and Convention, Chicago, IL, 8-10 November 1977, Electrical and Electronics Exhibitions, Inc.

Table 1

Categorical Breakout of IICEP

1. General
   - Coordination
   - Environmental Quality
   - Environmental Impact Statements
   - A-95 Clearinghouse
   - Transportation
2. Air Resources
   - General
3. Energy
   - General
   - Facility Siting
4. Health and Safety
   - General
   - Civil Defense
   - Occupational Health
   - Pesticides
   - Radiation
   - Building Codes
   - Safety
5. Land Use
   - Planning
   - Agriculture
   - Coastal Zone Management
   - Minerals and Geology
6. Natural Resources
   - Land Management and Grounds Maintenance
   - Fish and Wildlife
   - Recreation
   - Forestry
   - Archaeology and Historic Preservation
   - Flood Control
   - Oil and Gas
7. Noise
   - General
8. Socioeconomics
   - Economic Development
   - Education
   - Housing
   - Local Government
   - Social Services
9. Solid Waste
   - General
10. Transportation
    - General
    - Aeronautics
    - Highways
11. Water
    - General
    - Water Resources Management

The IICEP directory contains information allowing the user to decide whether a particular environmental planning issue falls under the responsibility of an agency, and lists the point of contact at each agency. IICEP listings provide the agency's name and function, address, telephone number, and contact person, as shown by the examples in Appendix A. Interim Air Force Environmental Planning Bulletins 14 and 15 have clarified the general concepts of IICEP use and hierarchically organized the data originally contained in the directory. However, CERL's research on IICEP has indicated that updating the information is the most serious problem with the directory and the computerized system, primarily because the jurisdictions and duties of agencies identified in IICEP are vague and change frequently.

Interim Air Force Environmental Planning Bulletin 15, Volume II, lists environmental contacts for Federal agencies. The IICEP pilot program used these contacts as the basis for developing the computer-based retrieval system. The listings contained in the three volumes of contacts for the state environmental planning agencies will be incorporated in the IICEP computer program at a later date.

3 THE PILOT SYSTEM: ORGANIZATION AND STRUCTURE

For the three-volume directory of state environmental planning agencies, Volume II of Interim Air Force Environmental Planning Bulletin 15, and the computerized system, the information in IICEP is organized around a unit of data called a "contact." A given contact consists of information about some individual in the Government, and thus generally lists a name, title, address, and phone number. In addition, a contact includes keyword data which enable an IICEP user to locate the contacts of interest. The keywords currently fall into the following seven categories.

1. "agency"

This category consists of the abbreviated name of the 30 major agencies of the executive branch of the Federal Government. For example, "doc" and "doa" are agency keywords corresponding to the Departments of Commerce and Agriculture. All contacts belonging to the Department of Commerce include "doc" as one of their keywords. A complete list of the agencies and their corresponding keywords is given below:

Advisory Council on Historic Preservation	ach
Civil Aeronautics Board	cab
Community Services Administration	csa
Department of Agriculture	doa
Department of Commerce	doc
Department of Defense	dod
Department of the Interior	doi
Department of Justice	doj
Department of Labor	dol
Department of State	dos
Department of Transportation	dot
Environmental Protection Agency	epa
Energy Research and Development Administration	erd
Executive Office of the President	exo
Farm Credit Administration	fca
Federal Energy Administration	fea
Federal Maritime Commission	fmc
Federal Power Commission	fpc
General Services Administration	gsa
Department of Health, Education and Welfare	hew
Department of Housing and Urban Development	hud
National Aeronautics and Space Administration	nas
Nuclear Regulatory Commission	nrc
National Science Foundation	nsf
National Transportation Safety Board	nts
Small Business Administration	sba
Smithsonian Institution	si
Treasury Department	td
Veterans Administration	va
Water Resources Council	wrc

2. "sub-agency"

This category corresponds to the next level below "agency" in the Government hierarchy. For example, "bureau of the census" is a subagency keyword occurring in some of the contacts belonging to the Department of Commerce.

3. "region"

This category consists of the names of the Federal regions. Unfortunately, many Federal agencies have adopted nonstandard regional divisions. Therefore, these keywords must be taken in the context of the appropriate Federal agency. The 10 standard Federal regions—"region 1" through "region 10"—are included in this category, as well as regions like the "atlanta region" of the Department of Commerce.

4. "state"

This category consists of the 50 state names and the term "us," which refers to the whole United States. Users who seek contacts concerning some issue in an individual state should retrieve the contacts having that state as a keyword (such as Ohio, "oh," or Alabama, "al"), as well as those having "us" as a keyword.

5. "topic"

This category consists of the 11 general topics listed in the following section.

6. "sub-topic"

This is a subcategory of the "topic" category. The following list gives various topics; the subtopics under each are indented.

a. general
   - coordination
   - environmental quality
   - environmental impact statements/A-95 clearinghouse
   - transportation

b. air resources
   - general air

c. energy
   - general energy
   - facility siting

d. health and safety
   - general health and safety
   - civil defense
   - occupational health
   - pesticides
   - radiation
   - building codes
   - safety

e. land use
   planning
   agricultural
   coastal zone management
   minerals and geology

f. natural resources
   land management and ground maintenance
   fish and wildlife
   recreation
   forestry
   archaeology and historic preservation
   flood control

g. noise
   general noise

h. socioeconomics
   economic development
   education
   housing
   local government
   social services

i. solid waste
   general solid

j. transportation
   aeronautics
   highways

k. water
   general
   water resources management

7. "program"

This category contains the names of the 26 Air Force programs.

air installation compatible use zone	aicuz
air pollution	ap
airfield and airspace criteria	aac
coastal zone management	czm
compliance with pollution controls	cwpc
comprehensive plan	cp
energy conservation	ec
environmental impact assessments and statements	eias
explosive safety criteria	esc
fish and wildlife and endangered species	fwes
forest management	fm
grazing and agricultural outleasing	gao
interagency/intergovernmental coordination (a-95)	a-95
joint use of military airfields	juma
land management and landscape development	lmld
military construction program (programs)	mcpp
military construction program (construction)	mcpc
military family housing	mfh
noise pollution	np
outdoor recreation and cultural resources	orcr
pesticide use and control	puc
real property and acquisition	rpa
real property disposal	rpd
reducing flight disturbances	rfd
solid waste	sw
water pollution	wp

4 COMMAND STRUCTURE

This chapter discusses the commands available to the IICEP user. Appendices B and C provide the software description and source code for IICEP, respectively, if further clarification is necessary. Table 2 lists and briefly describes IICEP commands.

Selection Commands

The IICEP system maintains a list of all contacts in the data base. By using keywords with the selection commands described below, a user can narrow this list to those contacts of interest.

1. "find"

The "find" command sets the list of contacts equal to those associated with a given keyword. For example, "find doc" sets the current list to contain all the contacts in the Department of Commerce. The find command can be used to retrieve a specific contact. For example, "find # 162" brings the contact number 162 to the current list.

2. "and"

The "and" command limits the current list to contacts already in the list and associated with a given keyword. For example, suppose a user types

"find hew"

"and radiation"

Table 2

Pocket IICEP: Reference For Using IICEP Information Retrieval Program

IICEP Command Glossary

Command Format	Description	Categories (use with "list" and "peek" commands)	Keyword (use with "find," "and," "or" and "except" commands)
find <keyword>	-sets current subset of contacts equal to those associated with given keyword.		
and <keyword>	-limits current subset to those associated with the given keyword.	agency	e.g., epa
or <keyword>	-augments current subset with those associated with the given keyword.	sub-agency	e.g., enforcement
except <keyword>	-removes from current subset those contacts associated with the given keyword.	region	e.g., region 6
save <filename>	-saves current list in the specified file.	state	e.g., texas
restore <filename>	-replaces current list with list of contacts stored in specified file.	topic	e.g., land use
restore	-replaces current list with previous list.	sub-topic	e.g., planning
list <category 1> <category 2>	-displays keywords associated with contacts in current list for the given category or categories. (IMPORTANT: if more than one category is to be specified, they should be ordered as follows: <narrower> <broader> e.g., list agency sub-agency)	program	e.g., aicuz
peek <category>	-invokes the editor on a copy of system file which contains keywords for given category. "q" returns to IICEP.		
show	-displays contact number, keywords, name, title, address phone number, and possibly comments for each contact in the current list.		
help <term>	-prints message about the given term.		
help	-prints summary of commands and references to more specific topics.		
quit	-exits IICEP program.		

The first command sets the current list to all the contacts in the Department of Health, Education, and Welfare. The second command limits that list to those concerned with radiation. The "and" command can be used to retrieve a specific contact. For example, "find #234" "and #678" bring the contact numbers 234 and 678 to the current list.

3. "or"

The "or" command augments the current list to include the contacts associated with a given keyword, and can be used to retrieve a specific contact. For example, suppose a user types

"find us"

"or alabama"

The first command sets the current list to include all contacts having national jurisdiction. The second command expands this list to include contacts with jurisdiction only in Alabama and the Federal government. At this point, the user might wish to further modify the list, for example, by typing

"and radiation"

The three commands create a list of all contacts associated with radiation in Alabama.

4. "except"

The "except" command, which modifies the current list by excluding contacts associated with the given keyword, can be used to exclude specific contacts. For example,

"find radiation"

"except hew"

establishes a list of contacts—other than those in "hew"—associated with radiation. As the selection commands narrow the current list of contacts, the IICEP program reports the number of contacts in the list. When this number is small enough, the user may use the "show" command to see the actual contact data. This command is invoked by simply typing "show" at the keyboard. For each contact in the list, the contact number, keywords, name, title, address, phone number, and any comments are displayed on the terminal. The contact numbers displayed by the "show" command can be used as keywords with any of the selection commands. For example,

"find alabama"

"show"

•

•

•

"except # 435"

"except # 932"

might be used to eliminate contacts that are not of interest.

Save and Restore Commands

Once the user has narrowed contacts down to those of interest, he/she may wish to save this list for future reference. This can be done with the "save" command. For example, if the user types

"save testfile"

the current list is written to a file named "testfile." The file name can be any character string up to 14 characters long. Lists saved in this way can be recovered later by typing

"restore <filename>"

For example,

"restore testfile"

would recover the list saved by the "save testfile" command. The "restore" command can also be used to recover from errors made during the selection process. The "restore" command used without any filename causes the previous list of contacts to be restored as the current list. Suppose a user types

"find texas"

"and alabama"

"restore"

The result of this series of commands is a current list of all contacts associated with "texas" and "alabama." Since these resulted in a null set, the "restore" command reestablished only the set of "texas" contacts without reestablishing the entire search.

List and Peek Commands

The selection commands described earlier are useful only if the user knows which keywords to use. For example, "Bureau of Census" is a keyword, but "Census Bureau" is not. Therefore, two additional commands have been provided to furnish information on keywords. The "list" command displays all the keywords from a given category that apply to the current list of contacts. The number of contacts in the current list which corresponds to a given keyword is displayed alongside that keyword. For example,

"find radiation"

"list agency"

displays all the agencies which have contacts concerned with radiation.

DOC (1)
EPA (5)
ERD (3)
HEW (1)
NRC (21)

Each of these agencies is a "keyword" associated with the subtopic "radiation." If the selection commands have been used to modify the current list of contacts,

"find all"

can be used to set the current list to contain all the contacts in the data base. Thus,

"find all"

"list agency"

produces a list of all agencies in the data base. The "list" command can be invoked with more than one category name. If the user types

"list sub-agency agency"

the program responds with a list of subagencies and the agencies to which they belong. In general, this feature should be used only when the first category is a subcategory of each subsequent category. The program will respond in any case, but the information generated may be misleading. Suppose the user types

"list state agency"

In this case, the first category is not a subcategory of the second, and when the program responds with

"alabama"

"agency: doa"

it only means that "doa" is one of the agencies having a contact where Alabama is a keyword.

The other command designed to provide information on keywords is the "peek" command. This command invokes the operating system's editor on a copy of the IICEP system keyword file for a given category. As an example,

"peek sub-topic"

invokes the editor on the file of "sub-topic" keywords. Then,

"g/waste/p"

prints a list of all keyword terms which contain the word "waste." Finally,

"q"

quits the editor session and returns the user to the IICEP program.

Help and Quit Commands

A "help" command has been provided to help acclimate the user to using the system. If the user simply types

"help"

the system responds with a message that briefly summarizes the IICEP commands. For further information, the user can type

"help <term>"

and the system will respond with a message providing information about the given term. For example,

"help list"

gives a brief message concerning the use of the list command. Many help messages refer to other terms that can be used with the help command. By following these chains of reference with the "help" command, many questions can be answered without the aid of a manual. The last command that a user must know is the "quit" command. When the user types

"quit"

the IICEP session is ended.

5 SUMMARY AND RECOMMENDATIONS

This report has documented the organization and command structure of a pilot IICEP computerized system operating in interactive mode as a subsystem

of ETIS. The study also identified difficulties in implementing IICEP. The most serious problem with both the IICEP directory and system is the task of updating the information. The jurisdictions and duties of the various identified agencies are nebulous and change constantly.

Nonetheless, the IICEP program could be a valuable source of information to Air Force planners. If the information were maintained in a central data base accessible by remote terminal and capable of supporting interactive usage, the system could be updated constantly with minimal effort, and users could access it from the central source (the interactive system). Incorporating IICEP into ETIS would allow the user to access IICEP's information without having to learn to operate a new system.

It is recommended that selected potential users (the Air Force Regional Civil Engineering offices, for example) use excerpts from this document to analyze the usefulness of the software produced under this research and development effort. The suggestions resulting from such a review could form the basis for modifying and improving the system.

Furthermore, an update procedure could be set up as part of an effort already contemplated for the ETIS operational component now being established for Army users. The additional update of the IICEP data could be integrated into existing procedures for CELDS and EIFS with little increase in long-term operational costs.

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APPENDIX A:

SAMPLE DATA FROM IICEP DIRECTORY

STANDARD FEDERAL REGION V

A. **Illinois**
1. **General**

ILLINOIS
General
Environmental Quality

a. **Agency**

Environmental Protection Agency
2200 Churchill Road
Springfield 62706

(217) 782-3397

Richard H. Briceland, Director

Function—The Agency coordinates programs for air quality, noise, solid waste and water quality.

State Laws—The Agency is established by S.L., Chapter III½, Section 1004.

Federal Laws—(See functional headings.)

ILLINOIS
General
A-95 Clearinghouse

b. **Agency**

Bureau of the Budget
103 State House
Springfield 62706

(217) 782-4520

Leonard Schaeffer, Director

Function—The Bureau is responsible for reviewing federally financed projects in accordance with A-95 procedures.

State Laws—None identified.

Federal Laws—The Bureau coordinates state review of federally assisted projects pursuant to OMB Circular No. A-95.

c. **Agency**

Department of Transportation
2300 S. Dirksen Parkway
Springfield 62706

(217) 782-5597

Langhorne Bond, Secretary

Function—The Department plans and develops state transportation systems. It develops and implements mass transit programs, plans airports, promotes transportation safety and constructs and maintains highways.

State Laws—The Department is established by the Civil Administrative Code of 1917.

Federal Laws—(See functional headings.)

2. **Air Resources**

a. **Agency**

Division of Air Pollution Control
Environmental Protection Agency
2200 Churchill Road
Springfield 62706

(217) 782-6514

John Moore, Division Director

Function—The Division administers and enforces state air pollution laws and reviews applications for permits.

State Laws—The Division is established under the Environmental Protection Act of 1970, as amended. The Division operates under the following laws and regulations: Stationary Sources Standards, 1972, as amended; Air Quality Standards, 1973; Episodes Regulations, 1976; Open Burning Regulations, 1971, as amended; and Odors Regulations, 1972.

Function—The Division administers state responsibilities under the Clean Air Act.

b. **Agency**

Pollution Control Board
309 West Washington Street
Chicago 60606

(312) 793-3620

Jacob D. Dumelle, Board Chairman

Function—The Board establishes air quality standards and regulations.

State Laws—The Board is established under the Environmental Protection Act of 1970, as amended. The Board operates under the following laws and regulations: General Air Pollution Regulations, 1972, as amended; Stationary Sources Standards, 1972, as amended; Air Quality Standards, 1973; Episodes Regulations, 1976; Open Burning Regulations, 1971, as amended; and Odors Regulations, 1972.

Federal Laws—The Board administers state responsibilities under the Clean Air Act.

3. **Energy**

ILLINOIS
Energy
General

a. **Agency**

Division of Energy
Department of Business and Economic Development
222 South College Avenue
Springfield 62702

(217) 782-5784

Sidney M. Marder, Director

Function—The Division conducts energy conservation programs and coordinates energy research within the state. The Division administers fuel allocation programs.

State Laws—The Division is organized under 78-1125, S.L. 1974.

Federal Laws—The Division administers energy conservation plans under the Federal Energy Administration Act of 1974.

b. **Agency**

Interstate Oil Compact Commission
(See Interstate Agency Appendix for details.)

APPENDIX B:

SOFTWARE DESCRIPTIONS

Hashing Subsystem

The hashing subsystem provides a means of looking up character strings in files of keywords. If a string is present in these titles, the lookup mechanism returns identifying data, specifying:

1. The number of keyword file in which the string is found

2. The keyword's number within each file

3. The byte offset of the keyword within each file.

The keyword files are specially formatted text files which are named with some fixed prefix such as "key," followed by a numeric string. Generally, it is best to organize keywords into coherent groups according to file numbers associated with each keyword type. For example, in the IICEP system, one category consists of state names, while another consists of agency names, so these categories should have different file numbers. In the files themselves, keywords are marked by a "#" character in column 1, followed by the keyword string, followed by a terminating ":" character. Characters following the ":" character and characters on subsequent lines are not part of the keyword string. This provides space for comments about the keyword. The next "#" character found in column 1 marks the end of the comments and the beginning of a new keyword.

Thus, the "hash" program sets up a hashtable which allows keyword data to be retrieved, but in order to use the "hash" program, another file must be prepared which itself names the keyword files. This file simply lists one keyword file name per line; the following is a current list of IICEP keyword files.

key.0	key.5
key.1	key.6
key.2	key.7
key.3	
key.4	

Then the "hash" program is invoked by

"hash <file list>"

where "<file list>" is the name of the file discussed above. The keyword files in the <file list> file are opened and read in order; each is scanned for keywords, and identifying data on each keyword are written to a temporary file. This temporary file is an array of struct elements defined as follows:

```
struct marker    /* word marker structure layout */
int file;        /* keyword file number          */
int idnum;       /* rel word # within file       */
long beginbyte;  /* byte offset of work in file  */
int hashv[3];    /* hash value                   */
```

Next, the "hash" program calls a subroutine named "maketable," which rearranges the contents of the temporary file into a hashtable. The "hashtable" file is also an array of struct elements defined as above; it is about half-empty at this point in the "hash" program, with the empty slots marked by setting the "file" field equal to −1. Slots occupied by struct elements corresponding to keywords from the keyword files are positioned as follows:

1. The total number of slots in the "hashtable" file minus a maximum overflow allowance defines a modulus.

2. The hash value included in a word marker struct is used to define a long integer.

3. The remainder of the long integer divided by the modulus yields a trial position in the hashtable.

4. The marker struct element is inserted into the first empty slot following the trial position.

The reader should consult the "maketable" subroutine source code (Appendix C) to see the actual mechanics of the temporary file of word markers reorganization into the "hashtable" file.

Once the "hashtable" file has been created, the "lookup" subroutine can be called from a "C" program to retrieve identifying data on any character string. The "lookup" routine computes a trial

position in the hashtable just as in steps 1, 2, and 3 above. Then the hashtable is searched until the first empty slot is encountered. The marker struct elements matching the given keyword are passed back to the calling procedure.

Setup Subsystem

The "setup" program scans files of IICEP data on contacts to prepare for retrieval of this data by the IICEP information retrieval program. The "setup" program is invoked by typing

"setup <file list>"

The argument "<file list>" is a file which names the IICEP files containing contact data. These names should be listed in the "<file list>" file, one per line: for example,

pc.0

pc.62

pc.125

pc.181

pc.241

pc.309

pc.377

pc.444

pc.518

pc.595

pc.678

pc.764

pc.841

pc.937

The files of contact data are named "pc.x," where "x" stands for the contact number of the first contact in the file. It is important that the files listed in "pclist" be ordered so that contacts are encountered in strictly increasing order. Each file contains data on one or more contacts, and each contact has the format given below:

<contact number>

<category number> : <keyword string>

<category number> : <keyword string>

•

•

•

•

<category number> : <keyword string>

&

<text data, including name, title, address, phone, comments>

In the format description above, the <contact number> field is a numeric string giving the number of the particular contact. Contacts are numbered beginning with zero and must be arranged in increasing order. Gaps are permissible, but tend to slow down the retrieval of data.

In the next section, each line gives a keyword string and the category (e.g., "agency," "region") to which it belongs. Presumably, the given string will be found in the keyword file numbered with the given category number. For example, the string for category two will be found in the keyword file for category two.

The latter section must be terminated by a line consisting of a single "&" character.

Succeeding lines contain text data about the contact; the next line containing a "#" character in the first column marks the beginning of a new contact.

The following is an example of data for a specific contact:

#61

0: doc

1: office of the secretary

4: socioeconomics

5: economic development

3: us

&

Jerry Jasinowski, Assistant Secretary for Policy (8-77)

14th Street, N.W.

Washington, DC 20203

(202) 377-2113

The "setup" program opens and reads the data files in the order they are listed in the "pclist" file. As "setup" scans the data, messages are printed, if

1. The numbering of the contacts is not consecutive.
2. A keyword is not present in the alleged keyword file.
3. The "&" line ending the keyword section is missing.

Under any of these conditions, the line number in the file is printed along with an appropriate message.

As the "setup" program scans the data files, the keyword data are digested and written to special files that will later be employed by the retrieval program. For each keyword category, a file named "pckey.X" is created. The "X" stands for the number of the corresponding keyword file. Each file lists the id numbers of the keywords pertaining to the contacts in the data files. A "pckey" file can be thought of as an array of integers. If the keyword id numbers for a given contact have no keywords from a given category, or if there is a gap in the contact numbers, then the -1 entry is still present to signify an empty list of keywords.

The "setup" program also creates an index file as it scans the contact data. Each entry in the index file contains the location of a given contact. This location consists of

1. The number of the "pc" file in which the contact occurs
2. The byte offset of the beginning of the contact
3. The byte offset of the text data for the contact.

If there is a gap in the numbering of the contacts, the missing entries in the index are marked with a -1 in each of the above three fields.

The Retrieval Program

When the "hash" and "setup" programs have been successfully run, the retrieval program "iicep" can be used. A complete description of the retrieval commands can be found in Chapter 4. The following discussion focuses both on the files required by the "iicep" program and on their functions. Five families of data files are used by the "iicep" program:

1. The "key." files containing keywords and comments
2. The "hashtable" of pointers to the "key." files
3. The "pc." files of textual contact data
4. The "pcndx" file indexing the "pc." files
5. The "pckey" files of keyword id numbers.

When the "iicep" program in invoked, a subroutine named "initlist" is called to construct a list of all the contacts in the data base. This is done by reading the "pcndx" file and noting those entries not marked as being empty. Thus, gaps in the sequence of contacts are detected and left out of the list of contact numbers. The list of contact numbers is represented as an array of integer entries and written to a disk file. An entry of -1 marks the end of the list.

The selection commands "find," "and," "or," and "except" modify this list. Each of these commands takes a keyword as an argument. The hashing lookup mechanism converts the keyword string into data specifying the appropriate keyword category and id number within that category. Next, the appropriate "pckey." file is scanned by the "keypcs"

routine to list those contact numbers in which the given keyword appears. Finally, the "bool" subroutine is called to perform the appropriate logical operation on this list of contact numbers and the previous list of contact numbers.

The "list" command scans the current list of contact numbers and the appropriate "pckey." file to determine which keyword id numbers from a given category are associated with the contacts in the current list. The result is a list of keyword id numbers and the number of contacts in which they appeared. Also listed is the number of a specific contact and the location within that contact where the keyword appeared. When this list is completed, the "pcndx" file is used to locate the contacts where the keywords are listed. The "pc." files are then opened and read in order to retrieve the actual keyword strings so that they can be printed to the user's terminal.

The "show" command runs through the current list of contact numbers and displays the data for each contact. This is done by finding the location of the contact data in the "pcndx" file and then reading the data from the appropriate "pc." file.

The "help" command uses the hashing lookup mechanism to convert a character string into data specifying the category number and byte offset of the string within the given keyword file. The keyword file is then read, and any comments following the keyword string in that file are displayed on the terminal.

APPENDIX C:

SOURCE CODE

```
Jul  6 14:09 1979  commandefs.i Page     1

    1   /* this file is included by both iicep.c and select.c    */
    2   /* it defines command numbers for switch statements      */
    3
    4   #define         FIND            0
    5   #define         AND             1
    6   #define         OR              2
    7   #define         EXCEPT          3
    8   #define         SAVE            4
    9   #define         RESTORE         5
   10   #define         SHOW            6
   11   #define         QUIT            7
   12   #define         PEEK            8
   13   #define         HELP            9
   14   #define         LIST            10
```

Jul 6 14:09 1979 keynames.i Page 1

```
 1  char *keynames[]
 2  {
 3          "agency",
 4          "sub-agency",
 5          "region",
 6          "state",
 7          "topic",
 8          "sub-topic",
 9          "program",
10          0,
11  };
```

```
Jul  6 14:30 1979  params.i Page      1

    1   #define         KEYNAME         "/usr/tmp/iicep/data/key."
    2   #define         HASHTBL         "/usr/tmp/iicep/reference/hashtable"
    3   #define         PCKEY           "/usr/tmp/iicep/reference/pckey."
    4   #define         PCNDX           "/usr/tmp/iicep/reference/pcndx"
    5   #define         PC              "/usr/tmp/iicep/data/pc."
    6
    7   #define         NUMTYPS         7
    8
    9   #define         MESSAGES        7
   10
   11   #define         ALL             "all"
```

```
 1
 2  #define         BUFRSIZ         256
 3
 4  struct keybufr
 5  {
 6          int descrip;            /* file descriptor                      */
 7          int *next;              /* next empty slot in bufr              */
 8          int *endbufr;           /* marks end of bufr                    */
 9          int bufr[BUFRSIZ];      /* buffer for keyword id numbers        */
10  };
11
12
13  struct marker           /* word marker structure layout */
14  {
15      int file;           /* keyword file number          */
16      int idnum;          /* rel word # within file       */
17      long beginbyte;     /* byte offset of word in file  */
18      int hashv[3];       /* hash value                   */
19  };
20
21
22  struct getlbuf                  /* for buffered input by line           */
23  {
24      int fildes;                 /* file descriptor of the given file    */
25      int nleft;                  /* number of chars left in buffer       */
26      char *nextp;                /* pointer to next char in buffer       */
27      char buff[512];             /* for buffered reads                   */
28  };
29
30
31
32
33  #define         NDXSIZ          256
34
35  struct ndx
36  {
37          int filenum;            /* number of file where entry occurs    */
38          long keylines;          /* byte offset of keyline section       */
39          long datalines;         /* byte offset of data section          */
40  };
41
42
43  struct ndxbufr
44  {
45          int fidndx;             /* descriptor of ndx file               */
46          struct ndx *nextndx;    /* next open slot in buffer             */
47          struct ndx *endndx;     /* marks end of buffer                  */
48          struct ndx bufndx[NDXSIZ];      /* buffer for index entries     */
49  };
50
51
52  struct keycheck
53  {
54          int keycount;                   /* number of occurences         */
55          int pcnum;                      /* id of pc where found         */
56          int keynum;                     /* number of key in pc keylines */
```

```
57  );
58
59
60  struct keymarker
61  {
62          int keytype;                    /* category of the keyword      */
63          char *keystring;                /* points to the keyword string */
64  );
65
66
67  #define         MAXKEYS         50      /* max keys per single pc       */
68  #define         MAXCHARS        1024    /* max chars in all keys per pc */
69
70  struct keydata
71  {
72      int totkeys;                        /* number of keys in a pc       */
73      struct keymarker keyptr[MAXKEYS];   /* point to all keys for a pc   */
74      char keybuf[MAXCHARS];              /* holds keystrings for a pc    */
75  );
```

```
1   #
2   /*****************************************************************************
3
4   NAME:
5
6           iicep ( main program )
7
8   FUNCTION:
9
10          Implement the commands of the IICEP system.
11
12  ALGORITHM:
13
14          The program begins by performing certain system initialization tasks.
15          In particular, "iam()" is called to select a unique name for the
16          process, and scratch files are created.  The scratch files are used
17          for listing the current and previous lists of contacts and they are
18          initialized to list all the contacts in the data base.
19
20          When the above operations are concluded, the program enters the
21          main command loop where the user is prompted to enter a command and
22          control is transfered to the sub-routine appropriate to executing
23          that command.
24
25  CALLS:
26
27          iam()
28          concat()
29          initlist()
30          resp()
31          copy()
32          execute()
33          table()
34          select()
35          save()
36          restore()
37          show()
38          peek()
39          help()
40          keyword()
41          list()
42
43          Also, Unix routines:
44
45          printf()
46          exit()
47          signal()
48          creat()
49          perror()
50          open()
51          setexit()
52          unlink()
53
54  HISTORY:
55
56          written by Dan Putnam - spring 1979.
```

```
 57
 58  ********************************************************************************/
 59
 60
 61  #include        "structdefs.i"  /* defines getlbuf                          */
 62  #include        "commandefs.i"  /* defines commands                         */
 63  #include        "keynames.i"
 64  #include        "params.i"      /* needed for KEYNAME only!! -Dan Putnam */
 65
 66  char *commtbl[] /* command names, must be consistent with commandefs.i  */
 67  {
 68          "find",
 69          "and",
 70          "or",
 71          "except",
 72          "save",
 73          "restore",
 74          "show",
 75          "quit",
 76          "peek",
 77          "help",
 78          "list",
 79          0,
 80  };
 81
 82  struct getlbuf bufin;           /* for line oriented input                  */
 83  char line[256];                 /* used with bufin                          */
 84  int count;                      /* character count returned from getl       */
 85
 86  int fidscratch[2];              /* file descriptors                         */
 87  int phase 0;                    /* used to alternate between files          */
 88
 89  char *keyprefix KEYNAME;        /* name of the keyword files                */
 90
 91
 92
 93  main(argc,argv)
 94  int argc;
 95  char **argv;
 96  {
 97      int reset();                /* used with setexit to handle breaks       */
 98      char buffer[256];           /* buffer for user response                 */
 99      char comm[256];             /* buffer for command string                */
100      char *src;                  /* utility pointer used with copy()         */
101      char *dst;                  /* utility pointer used with copy()         */
102      char me[10];                /* buffer for my unique name                */
103      char scratch[2][15];        /* names of scratch files                   */
104      int opcode;                 /* command number                           */
105      int quitflag;               /* loop control: main command loop          */
106      int num;                    /* number of pcs returned from initlist     */
107      struct marker *keyword();   /* returns pointer to keyword data          */
108
109
110      signal( 2, 1);              /* ignore interrupts                        */
111
112
```

```
113         printf("Welcome to the IICEP information retrieval program\n");
114         printf("For help, type 'help iicep commands'\n");
115
116
117         /****** create scratch files        */
118         /****** we will need to read and write on them, so close and reopen */
119
120
121         if(iam(me) < 0)
122         {
123             printf("can't create unique name, aborting\n");
124             exit();
125         }
126
127         concat(me, "0scratch", scratch[0]);
128         concat(me, "1scratch", scratch[1]);
129
130
131         fidscratch[0] = creat(scratch[0], 0666);
132         fidscratch[1] = creat(scratch[1], 0666);
133
134
135         if( fidscratch[0] < 0  ||  fidscratch[1] < 0 )
136         {
137             perror("pams, creat");
138             exit();
139         }
140
141         close( fidscratch[0] );
142         close( fidscratch[1] );
143
144         fidscratch[0] = open( scratch[0], 2);
145         fidscratch[1] = open( scratch[1], 2);
146
147         if( fidscratch[0] < 0  ||  fidscratch[1] < 0 )
148         {
149             perror("pams, open");
150             exit();
151         }
152
153
154         /****** initialize scratch files to list all pcs     */
155
156         num = initlist( fidscratch[0] );
157
158         printf("%d contacts in current list\n", num);
159         copyfile( fidscratch[0], fidscratch[1] );
160
161
162
163         /****** this is the main command loop        */
164
165         for(quitflag = 0; quitflag == 0;)
166         {
167             setexit();
168             signal(2, reset);
```

```
169             printf("\n\nWhat next?\n");
170
171             resp( buffer );          /* get user response                    */
172
173             src = buffer;
174             dst = buffer;
175             copy( &src, &dst, 0, sizeof( buffer )); /* omit extra blanks    */
176
177
178             /****** see if user wants to execute a Unix comand      */
179
180             if( *buffer == '!' )
181             {
182                 execute( buffer + 1 );
183                 continue;            /* go back to top of command loop       */
184             }
185
186
187
188             /****** copy characters into command string                     */
189
190
191             src = buffer;
192             dst = comm;
193             copy( &src, &dst, ' ', sizeof( comm ));
194
195
196             if( (opcode = table( comm, commtbl)) == -1 )
197             {
198                 printf("'%s' not a command\n", comm);
199                 continue;
200             }
201
202             /****** copy() has left src pointing at command argument string */
203
204             switch( opcode )
205             {
206                 /****** these commands select the current pc list           */
207
208                 case FIND:
209                 case AND:
210                 case OR:
211                 case EXCEPT:
212
213                     signal( 2, 1);          /* ignore interrupts here       */
214
215                     select( opcode, src);
216                     break;
217
218
219                 case SAVE:
220                     signal( 2, 1);          /* ignore interrupts here       */
221                     save( src );
222                     break;
223
224
```

```
225                 case RESTORE:
226                     signal( 2, 1);          /* ignore interrupts here       */
227                     restore( src );
228                     break;
229
230
231                 case SHOW:
232
233                     /****** don't ignore interrupts here    */
234                     show(fidscratch[ phase ], src);
235                     break;
236
237
238                 case QUIT:
239                     quitflag = 1;           /* this will get us out of loop */
240                     break;
241
242
243                 case PEEK:
244                     peek( src );
245                     break;
246
247
248                 case HELP:
249                     help(0, keyword( src ) );       /* 0 = standard output  */
250                     break;
251
252
253                 case LIST:
254                     list( fidscratch[phase], src);
255                     break;
256
257
258                 default:
259                     printf("'%s' is not yet implemented\n", buffer);
260                     break;
261             }
262         }
263
264
265         unlink( me );
266         unlink( scratch[0] );
267         unlink( scratch[1] );
268     }
```

```
#
/*****************************************************************************

NAME:

        catdata()

FUNCTION:

        Read the keyword lines for a contact into a "keydata" struct
        so that they can be more easily referenced.

CALLING SEQUENCE:

        int pcid
        int fidpc
        long offset
        struct keydata *pcdata

PARAMETERS:

        pcid            Accession number of the point of contact whose
                        data is being read.

        fidpc           File descriptor of the contact data file where the
                        data for the given pc resides.

        offset          Byte offset of the data in the given file.

        pcdata          Points to the structure which gets the key data
                        to be read from the file.

RETURNS:

        nothing.

ALGORITHM:

        The routine seeks into the file and reads the header.
        If these operations are successful, the routine enters
        a loop and reads the keyword lines into the "keydata"
        struct indicated by "pcdata".

CALLS:

        seekl()
        getl()
        copy()

        Also, Unix routines:

        printf()


CALLED BY:
```

```
57          snow()
58          list()
59
60  HISTORY:
61
62          written by Dan Putnam - spring 1979.
63
64  ***************************************************************************/
65
66
67
68  #include        "structdefs.i"  /* define getlbuf struct                 */
69
70
71
72  eatdata( pcid, fidpc, offset, pcdata)
73  int pcid;                       /* number of source permit              */
74  int fidpc;                      /* file descriptor of pc data file      */
75  long offset;                    /* byte offset of data for given pc     */
76  struct keydata *pcdata;         /* gets lines of keyword data           */
77  {
78      int keynumber;              /* counts number of keys in pc          */
79      struct keymarker *markptr;  /* points thru keyptrs of pcdata        */
80      char *bufptr;               /* points thru keybuf of pcdata         */
81      char *endptr;               /* points off end of keybuf             */
82      char *src;                  /* utility pointer used with copy()     */
83      char *dst;                  /* utility pointer used with copy()     */
84      char *end;                  /* marks end of pcdata buffer           */
85      char tag[100];              /* for grabbing tag off of a line       */
86      char line[256];             /* gets line lines from getl()          */
87      int nbytes;                 /* returned from getl                   */
88      struct getlbuf bufr;        /* used by getl()                       */
89
90
91
92      bufr.fildes = fidpc;
93      bufr.nleft = 0;
94
95      if( offset < 0  ||  seekl( fidpc, offset) < 0 )
96      {
97          printf("can't seek to data on pc %d\n", pcid);
98          return;
99      }
100
101
102
103     if( (nbytes = getl( line, &bufr)) <= 0 )
104     {
105         printf("can't find data on pc %d\n", pcid);
106         return;
107     }
108
109
110
111     keynumber = 0;
112     bufptr = pcdata -> keybuf;
```

```
113         markptr = pcdata -> keyptr;
114         while( (nbytes = getl( line, &bufr)) > 0 )
115         {
116             line[ nbytes - 1 ] = 0;          /* replace '\n' by null          */
117
118
119             if( line[0] == '&' )
120                 break;                  /* marks end of keywords             */
121
122             src = line;
123             dst = tag;
124             copy( &src, &dst, ':', sizeof( tag ));
125
126             if( keynumber > MAXKEYS )
127             {
128                 printf("MAXKEY limit exceeded\n");
129                 break;
130             }
131
132             markptr -> keystring = bufptr;
133             markptr -> keytype = atoi( tag );
134
135
136
137             if( copy(&src, &bufptr, 0, &(pcdata -> keybuf[MAXCHARS]) - bufptr) < 0)
138             {
139                 printf("MAXCHARS limit exceeded\n");
140                 break;
141             }
142
143             keynumber++;
144             markptr++;
145         }
146
147         pcdata -> totkeys = keynumber;
148     }
```

```
    1   #
    2   /*****************************************************************************
    3
    4   NAME:
    5
    6           getndx()
    7
    8   FUNCTION:
    9
   10           Find the location of the data for a given contact, and
   11           return a file descriptor for the data file.
   12
   13   CALLING SEQUENCE:
   14
   15           int pcid
   16           struct ndx *pc_ptr
   17           int getndx()
   18
   19   PARAMETERS:
   20
   21           pcid            The accession number of the contact of interest.
   22
   23           pc_ptr          Points to the index struct to be filled in with the
   24                           data giving the location of the given contact.
   25
   26   RETURNS:
   27
   28           Returns a file descriptor of the contact data file cortaining
   29           the given contact.
   30
   31   ALGORITHM:
   32
   33           This routine may be interrupted if the user hits the "rub-out"
   34           key.  If this happens, the index file won't get closed.  To
   35           handle this problem, the descriptor is stored in a static variable.
   36           The routine begins by examining this variable to see if it is
   37           non-zero.  If so, the file is closed and the descriptor is set to
   38           zero to mark the file as being closed.
   39
   40           The routine next opens the index file to read the index struct
   41           giving the location data for the given contact.  Then, the
   42           data file containing the given contact is opened and the
   43           file descriptor is returned.
   44
   45   CALLS:
   46
   47           Various Unix routines.
   48
   49           close()
   50           seek()
   51           read()
   52           perror()
   53
   54   CALLED BY:
   55
   56           show()
```

```
57          list()
58
59  HISTORY:
60
61          Adapted from the "getndx()" routine of the PAWS system - spring 1979.
62
63  ******************************************************************************/
64
65
66  #include        "structdefs.i"          /* defines pc index structure   */
67  #include        "params.i"              /* defines PCNDX                */
68
69  getndx(pcid, pc_ptr)
70  int pcid;                               /* number of pc that we want    */
71  struct ndx *pc_ptr;                     /* index to pc that we want     */
72  {
73      char pcfile[30];                    /* name of pc file              */
74      int file;                           /* pc file number where pc is   */
75      long offset;                        /* byte offset into  a file     */
76      int fidpc;                          /* descriptor of pc file        */
77      static int fidndx;                  /* descriptor for pc index file */
78
79
80
81      /****** make sure we close old files before using   */
82
83      if( fidndx != 0 )
84      {
85          close( fidndx );
86          fidndx = 0;             /* and mark it as closed                */
87      }
88
89
90
91
92      if( (fidndx = open(PCNDX, 0)) < 0 )
93      {
94          perror("getndx can't open pcndx file");
95          return( -1 );
96      }
97
98      offset = pcid;
99      offset *= sizeof( *pc_ptr );
100     if( seekl(fidndx, offset) < 0 )
101     {
102         perror("getndx can't seek into pc index");
103         return( -1 );
104     }
105
106     if( read(fidndx, pc_ptr, sizeof(*pc_ptr)) < sizeof(*pc_ptr) )
107     {
108         printf("can't read pc index file\n");
109         return( -1 );
110     }
111     close( fidndx );
112     fidndx = 0;                     /* mark it as closed                */
```

```
113
114         file = pc_ptr -> filenum;           /* this is pc file number       */
115         concat(PC, locv(0, file), pcfile);
116
117
118         if( (fidpc = open(pcfile, 0)) < 0 )
119         {
120             perror("getndx can't open pc file");
121         }
122
123
124         return( fidpc );
125     }
```

```
#
/*****************************************************************************

NAME:

        initlist()

FUNCTION:

        Initialize a file to list all the contacts in the data base.

CALLING SEQUENCE:

        int fidpc
        int initlist()

PARAMETERS:

        fidpc           File descriptor of the output list of pc accession
                        numbers.

RETURNS:

        Returns the number of accession numbers in the output list.

ALGORITHM:

        The routine opens the index file and reads from it in a loop.
        Empty index structs are marked by having their "filenum" fields
        set to -1.  Whenever a struct is encountered that is not empty,
        the corresponding accession number is inserted into the output
        buffer.

CALLS:

        Unix routines:

        seek()
        open()
        perror()
        exit()
        read()
        write()
        close()

CALLED BY:

        iicep ( main program )
        select()

HISTORY:

        written by Dan Putnam - spring 1979.

*****************************************************************************/
```

```
 57
 58  #include        "structdefs.i"
 59  #include        "params.i"
 60
 61  #define         PCSIZ           256
 62  #define         NDXSIZ          256
 63
 64  initlist( fidpc )
 65  int fidpc;                      /* descriptor of output list of pc ids  */
 66  {
 67      int pcbuf[PCSIZ];           /* output buffer for list of pc ids     */
 68      int *pcptr;                 /* points thru pcbuf                    */
 69      int fidndx;                 /* descriptor of input index file       */
 70      struct ndx ndxbuf[NDXSIZ];  /* input buffer for index file          */
 71      struct ndx *ndxptr;         /* points thru ndxbuf                   */
 72      register int n;             /* fast loop counter                    */
 73      int pcid;                   /* id of current pc in index list       */
 74      int countpc;                /* counts number of pc's in index       */
 75
 76
 77      seek( fidpc, 0, 0);         /* be sure to start at beginning        */
 78
 79      if( (fidndx = open( PCNDX, 0 )) < 0 )
 80      {
 81          perror("initlist can't open pcndx");
 82          exit();
 83      }
 84
 85      pcid = 0;                   /* pc ids begin with zero               */
 86      countpc = 0;                /* no pc's so far                       */
 87      pcptr = pcbuf;
 88
 89      while( (n = read( fidndx, ndxbuf, sizeof( ndxbuf ) )) > 0 )
 90      {
 91          n /= sizeof( *ndxbuf );         /* n = # of ndx entries         */
 92
 93          ndxptr = ndxbuf;
 94
 95          do
 96          {
 97              if( ndxptr++ -> filenum != -1 )
 98              {
 99                  /****** got one!        */
100
101                  countpc++;
102                  *pcptr++ = pcid;
103
104                  if( pcptr >= &pcbuf[PCSIZ] )
105                  {
106                      if( write(fidpc, pcbuf, sizeof(pcbuf)) < sizeof(pcbuf) )
107                      {
108                          perror("initlist can't write pc id's");
109                          exit();
110                      }
111
112                      pcptr = pcbuf;
```

```
113                     }
114
115                 }
116
117                 pcid++;                 /* bump pcid to id of next incex entry  */
118             }
119             while( --n );               /* count down on number of entries      */
120         }
121
122
123
124         /****** flush remaining pc id's in pcbuf    */
125
126         *pcptr++ = -1;                          /* null terminate list          */
127
128         n = (pcptr - pcbuf) * 2;
129
130         if( write( fidpc, pcbuf, n) < n )
131         {
132             perror("initlist can't flush pc list");
133             exit();
134         }
135
136         close( fidndx );
137
138         return( countpc );
139     }
```

```
#
/*****************************************************************************

NAME:

        keypcs()

FUNCTION:

        Make a list of the contacts associated with a given keyword.

CALLING SEQUENCE:

        int type
        int fidin
        int fidout
        int keypcs()

PARAMETERS:

        type            Id number of the given keyword.

        fidin           File descriptor of the "pckey." file for the category
                        of the given keyword.

        fidout          File descriptor for the output file which will list
                        the accession numbers of the contacts associated
                        with the given keyword.

RETURNS:

        Returns the number of contacts associated with the given keyword.

ALGORITHM:

        The routine reads through the "pckey." file given by the "fidin"
        file descriptor.  Each -1 entry in the file bumps the current
        pc number by one in order to keep track of which pc accession
        number is current.  When an entry matches the "type" argument,
        the current pc accession number is inserted into the output
        buffer.  The "previous" variable keeps track of the last accession
        number to be put into the output list, and the routine checks to
        be sure that no accession number is inserted twice.  This step
        is neccessary in case a keyword has been entered twice in the same
        contact in the data base.

CALLS:

        Unix routines:

        seek()
        read()
        write()

CALLED BY:

```

```
57          select()
58
59  HISTORY:
60
61          written by Dan Putnam - spring 1979.
62
63  ********************************************************************************/
64
65
66  #define         INSIZ           1024            /* size of input buffer */
67
68  #define         OUTSIZ          256             /* size of out buffer   */
69
70  keypcs(type,fidin,fidout)
71  int type;                       /* locate pc's with this key            */
72  int fidin;                      /* descriptor for pc key file           */
73  int fidout;                     /* descriptor for qualified pc file     */
74  {
75
76      int count;                  /* counts number of qualified pc's      */
77      int inbuf[INSIZ];           /* input buffer for pc key file         */
78      int outbuf[OUTSIZ];         /* output buffer for qualified pc's     */
79      int *outptr;                /* points to next open slot in outbuf   */
80      int pcid;                   /* current pc id number                 */
81      int previous;               /* id number of last pc put in outbuf   */
82      register int n;             /* for loop counting thru pc key list   */
83      register int *idptr;        /* grabs id numbers out of list         */
84      register int idkey;         /* equals id # of current key in list   */
85
86
87      count = 0;
88      pcid = 0;
89      previous = -1;
90      outptr = outbuf;
91
92      seek(fidin, 0, 0);                          /* start at beginning   */
93      seek(fidout, 0, 0);                         /* start at beginning   */
94
95      while( (n = read(fidin, inbuf, INSIZ * 2)) > 0 )
96      {
97          n =/ 2;         /* n = # of  entries in buffer                  */
98
99          idptr = inbuf;
100
101         do
102         {
103             if( (idkey = *idptr++) == -1 )
104                 pcid++;
105
106             else
107             {
108                 if( idkey == type  &&  pcid > previous )
109                 {
110                     /****** got one!    */
111
112                     count++;
```

```
113                         previous = pcid;    /* to avoid repetion          */
114                         *outptr++ = pcid;
115
116                         if(outptr >= &outbuf[OUTSIZ])
117                         {
118                             write(fidout,outbuf,(outptr - outbuf) * 2);
119                             outptr = outbuf;
120                         }
121                     }
122                 }
123             }
124             while( --n );
125         }
126         /****** terminate list and write out        */
127
128         *outptr++ = -1;
129
130         write(fidout,outbuf,(outptr - outbuf) * 2);
131         return(count);
132     }
```

```
#
/*****************************************************************************

NAME:

        list()

FUNCTION:

        Implement the "list" command of IICEP.

CALLING SEQUENCE:

        int fidpclist
        char *arg

PARAMETERS:

        fidsplist       File descriptor of the current list of contact
                        accession numbers.

        arg             Points to string containing keyword category names
                        that are to be listed.

RETURNS:

        nothing.

ALGORITHM:

        The list command can be interrupted by the user by hitting the
        "rubout" key.  This operation can leave opened files.  To deal
        with this problem, file descriptors are stored in static variables.
        The routine begins by examining these variables to see if they are
        non-zero.  If so, the files are closed and the descriptors are
        set to zero to mark the files as being closed.

        The next operation that is performed is to parse the argument
        string given by "arg".  The string is broken down into sub-strings
        delimited by blanks.  The "keynames" array is searched to see
        if these sub-strings are indeed valid keyword category names.
        If so, the index in the array which matches a sub-string is saved
        to identify the category.

        The first category named in the argument string drives the operation
        of the list command.

        The routine loops to pick up the keys from the first argument
        category that occur in the current list of contacts.
        This is accomplished through the call to "listcheck()" which
        drives the loop.  This sub-routine fills out the "checklist" array
        which keeps track of:

                1. The number of contacts in the current list which contain
                   a given keyword.
```

```
57                      2. The accession number of one of the contacts that
58                         contains a given keyword.
59
60                      3. The number of keywords from the given category which precede
61                         the keyword in the contact named by item 2 above.
62
63              Items 2 and 3 provide a way of recovering a keyword in order to
64              print it.  Number 2 gives a contact where it occurs and number
65              3 indicates which of the keys it is.  Since the "listcheck()" array
66              has limited length, it covers just a sub-range of the possible
67              keyword id numbers on each loop iteration.  On each call, "listcheck()"
68              returns the smallest id number of a keyword occuring in the current
69              list of contacts which has not yet been considered in the
70              "checklist" array.  This provides a lower bound for the next iteration.
71
72              Once the "checklist array has been filled out for an iteration,
73              the routine prints out the keyword data for the checked keys.  If the
74              "checklist" struct for a key has not been checked, then nothing is
75              printed.  Otherwise, the contact data is read and the given
76              keyword string is printed as it appears in the contact data file.
77              If any other categories were named in the argument list, then the
78              keywords from those categories which occur in the contact data
79              are also printed.
80
81      CALLS:
82
83              copy()
84              table()
85              concat()
86              resp()
87              listcheck()
88              getndx()
89              getdata()
90
91              Also, Unix routines:
92
93              close()
94              printf()
95              locv()
96              open()
97              perror()
98
99      CALLED BY:
100
101             show()
102
103     HISTORY:
104
105             written by Dan Putnam - spring 1979.
106
107     ***************************************************************************/
108
109
110
111     #include        "structdefs.i"
112     #include        "params.i"
```

```
113
114  #define          CHECKSIZ                256
115
116
117
118
119
120  list(fidpclist, arg)
121  int fidpclist;          /* file descriptor of current pc list          */
122  char arg[];             /* contains arguments of list command          */
123  {
124      struct keycheck checklist[CHECKSIZ];        /* marks found keys    */
125      struct keycheck *checkptr;          /* points thru checklist       */
126
127      int type;                       /* number of chosen category       */
128      int argtype;                    /* type of other arguments         */
129      int keynumber;                  /* number of key among keys of a pc*/
130      int i;                          /* counts keys of a given type     */
131      int occurs;                     /* number of current pc's with this key */
132      extern char *keynames[];        /* names of keyword categories     */
133      struct keydata pcdata;          /* picks up keyword lines for pcs  */
134      struct keymarker *markptr;      /* points thru keymarkers in pcdata*/
135      int arglist[20];                /* argument numbers of show        */
136      int invalid;                    /* flag = 1 if an argument is invalid */
137      int argnum;                     /* loop control: counts arguments  */
138      int num;                        /* id number of an argument        */
139      char reply[256];                /* gets user response to prompt    */
140      int lo;                         /* low id in range passed to listcheck */
141      int hi;                         /* high id in range passed to listcheck */
142      char *string;                   /* points to individual arg strings*/
143      char *src;                      /* utility pointer used with copy()*/
144      char *dst;                      /* utility pointer used with copy()*/
145      char *key;                      /* points to keyword string in pcdata */
146      register int pcid;              /* id number of contact in lists   */
147      struct ndx pcindex; /* offsets of data in pc file          */
148      char pckeyfile[100];            /* for building pckey filename     */
149      static int fidpc;               /* file descriptor for pc data file */
150      static int fidpckey;            /* file descriptor for pckey data file */
151
152
153
154      /****** make sure file descriptors are closed before using again  */
155
156      if( fidpc != 0 )
157      {
158          close( fidpc );
159          fidpc = 0;
160      }
161
162      if( fidpckey != 0 )
163      {
164          close( fidpckey );
165          fidpckey = 0;
166      }
167
168
```

```
169
170
171
172
173         /******  parse argument string       */
174
175         invalid = 0;                          /* assume all arguments ok       */
176         argnum = 0;
177
178
179         src = arg;
180         string = src;
181         dst = src;
182         while( copy( &src, &dst, ' ', 100) > 1 )
183         {
184
185             if( (num = table( string, keynames )) < 0 )
186             {
187                 printf("'%s' is not a valid argument\n", string);
188                 invalid = 1;
189             }
190
191             arglist[ argnum++ ] = num;
192             string = src;                     /* save start of string          */
193         }
194
195         if ( invalid )
196             return;                  /* try again                              */
197
198         arglist[ argnum ]  = -1;     /* terminate list of argument codes       */
199
200
201         if( argnum == 0 )
202         {
203             return;
204         }
205
206         type = arglist[0];
207
208         concat(PCKEY, locv( 0, type), pckeyfile);
209
210         if( (fidpckey = open(pckeyfile, 0)) < 0 )
211         {
212             perror("list can't open pckey file");
213             return;
214         }
215
216
217
218
219         lo = 0;
220         hi = CHECKSIZ - 1;
221
222
223         do
224         {
```

```
225             lo = listcheck( fidpclist, fidpckey, checklist, lo, hi);
226             hi = lo + CHECKSIZ - 1;
227
228             for( checkptr = checklist; checkptr < &checklist[CHECKSIZ]; checkptr++)
229             {
230
231                 if( checkptr -> keycount == 0 )
232                     continue;
233
234
235                 pcid = checkptr -> pcnum;
236                 keynumber = checkptr -> keynum;
237                 occurs = checkptr -> keycount;
238
239                 if( (fidpc = getnox( pcid, &pcindex)) < 0 )
240                     continue;
241
242
243                 eatdata( pcid, fidpc, pcindex.keylines, &pcdata);
244
245                 close( fidpc );
246                 fidpc = 0;          /* mark it as being closed              */
247
248                 i = 0;
249
250                 for( markptr = pcdata . keyptr; ;markptr++)
251                 {
252                     if( markptr -> keytype == type )
253                     {
254                         if( i++ == keynumber )
255                             break;
256                     }
257                 }
258
259
260                 printf("%s \( %d \)\n", markptr -> keystring, occurs);
261
262                 for( argnum = 1; ( argtype = arglist[ argnum ] ) != -1; argnum++)
263                 {
264                     for( keynumber = 0; keynumber < pcdata . totkeys; keynumber++)
265                     {
266                         if( pcdata . keyptr[ keynumber ] . keytype  ==  argtype )
267                         {
268                             key = pcdata . keyptr[ keynumber ] . keystring;
269                             printf("    %s: %s\n\n", keynames[argtype], key);
270                             break;
271                         }
272                     }
273                 }
274             }
275         }while( lo >= 0 );
276
277         close( fidpckey );
278         fidpckey = 0;       /* mark it as being closed                      */
279     }
```

```
#
/*****************************************************************************

NAME:

        listcheck()

FUNCTION:

        Fill in a checklist indicating the presence of keywords
        in a list of contacts.

CALLING SEQUENCE:

        int fidpclist
        int fidpckey
        struct keycheck *checklist
        int lo
        int hi

PARAMETERS:

        fidpclist       File descriptor for the list of current contact
                        accession numbers.

        fidpckey        File descriptor for the "pckey." file listing
                        keyword id numbers of keywords occuring in
                        contacts.

        max             Maximum number of keywords per contact
                        from the given category.  Effectively gives
                        the length of the "rows" of the pckey file.

        checklist       The structs in this array give information
                        about the occurence of keywords in the current
                        contact list:

                                1. The number of permits in the current
                                list which contain a given keyword.

                                2. The accession number of one of the
                                contacts that contains a given keyword.

                                3. The number of keywords from the given
                                category which precede the keyword in the
                                contact named by item 2 above.

        flag            If this flag is set, only want to get keywords whose
                        high bits are set to denote non-compliance.

        lo              Defines the low end of the range covered by
                        the checklist array.

        hi              Defines the high end of the range covered by
                        the checklist array.

```

```
RETURNS:

        Returns the smallest id number of the keywords occuring in the current
        list of contacts, but not yet checked in the "checklist" array.
        Presumably, this value will be used for the "lo" parameter on the
        next call to this routine.  If there is no such smallest id number,
        the routine returns -1 to signify that all the keywords have been
        covered.

ALGORITHM:

        A pass is made through the "checklist" array to initialize it to
        empty.  Then, the input buffer for the current contact list
        is filled to prepare for the main loop.  In the main loop, each
        iteration considers an accession number of a contact in
        the current list of contacts.  The routine moves through
        the "pckey." file to locate the "row" correpconding to the given
        contact number.  The keys listed in this row are checked
        in the "checklist" provided that they fall into the range
        defined by "lo" and "hi", and they match the "flag" parameter.

CALLS:

        seekl()

        Also, Unix calls:

        seek()
        read()
        perror()

CALLED BY:

        list()

HISTORY:

        written by Dan Putnam - spring 1979.

*****************************************************************************/



#include        "structdefs.i"          /* define keycheck struct       */

#define         PCLISTSIZ       256     /* buf size for current pc list */
#define         PCKEYSIZ        768     /* buf size for pckey file      */

listcheck( fidpclist, fidpckey, checklist, lo, hi)
int fidpclist;                  /* descriptor for current list of pcs   */
int fidpckey;                   /* descriptor for pckey file            */
struct keycheck checklist[];    /* used to keep track of founc keys     */
int lo;                         /* key id # of base entry in checklist  */
```

```
113   int hi;                          /* key id # of last entry in checklist  */
114   {
115       int newlo;                           /* smallest key id > hi          */
116       int pclist[PCLISTSIZ];               /* buffer for current pc list    */
117       int *pclistptr;                      /* points thru pclist            */
118       int *endpclist;                      /* points off end of pc list     */
119       int pckeylist[PCKEYSIZ];             /* buffer for pckey file         */
120       int *pckeyptr;                       /* points thru pckey entries     */
121       int *endpckey;                       /* marks end of pckey buffer     */
122       int pcid;                            /* id number of pcs in pclist    */
123       int keypc;                           /* id of pc of pckey entries     */
124       int keyval;                          /* keyword value in pckey file   */
125       int keynumber;                       /* number of keyval in list      */
126       int nbytes;                          /* returned from reads           */
127       struct keycheck *checkptr;           /* runs thru check list          */
128       int i;                               /* loop control: checklist       */
129
130
131
132
133       newlo = 0077777;                              /* largest pos integer  */
134       keypc = 0;                                    /* pc of first keys     */
135
136
137
138
139
140       /****** init checklist to none found         */
141
142       checkptr = checklist;
143       for( i = lo; i <= hi; i++)
144       {
145           checkptr -> pcnum = -1;
146           checkptr++ -> keycount = 0;
147       }
148
149
150
151
152       seek( fidpclist, 0, 0);      /* be sure to start at the beginning     */
153       seek( fidpckey, 0, 0);       /* be sure to start at the beginning     */
154
155
156       /****** fill up pc list buffer to get started       */
157
158       if( (nbytes = read(fidpclist, pclist, PCLISTSIZ * 2)) < 0 )
159       {
160           perror("list can't read current pc list");
161           return;
162       }
163
164       pclistptr = pclist;
165       endpclist = pclist + (nbytes / 2);           /* pts off end of list  */
166
167
168       /****** fill up pckey buffer to get started */
```

```
169
170         if( (nbytes = read(fiopckey, pckeylist, PCKEYSIZ * 2)) < 0 )
171         {
172             perror("list can't read pckey file");
173             return;
174         }
175
176         pckeyptr = pckeylist;
177         endpckey = pckeylist + (nbytes / 2);        /* pts off end of list  */
178
179
180
181         /****** run thru current pc list to get keys for each one   */
182
183         while( (pcid = *pclistptr++) != -1 )        /* null terminated      */
184         {
185             /****** first check if we have used up pc buffer        */
186
187             if( pclistptr >= endpclist )
188             {
189                 /****** refill buffer and reset pclistptr   */
190
191                 if( (nbytes = read(fidpclist, pclist, PCLISTSIZ * 2)) < 0 )
192                 {
193                     perror("list can't read current pc list");
194                     return;
195                 }
196
197                 pclistptr = pclist;
198                 endpclist = pclist + (nbytes / 2);  /* pts off end of list  */
199             }
200
201
202             /****** next, read up to proper section of pckey file   */
203
204             while( keypc < pcid )
205             {
206                 if( *pckeyptr++ == -1 )
207                     keypc++;                /* run thru unwanted key ids    */
208
209
210                 if( pckeyptr >= endpckey )
211                 {
212                     if( (nbytes = read( fidpckey, pckeylist, PCKEYSIZ * 2)) < 0 )
213                     {
214                         perror("list can't read pckey file");
215                         return;
216                     }
217
218                     pckeyptr = pckeylist;
219                     endpckey = pckeylist + (nbytes / 2);
220                 }
221             }
222
223
224             /****** run thru keys for pcid and put in checklist     */
```

```
225
226
227             for( keynumber = 0;  (keyval = *pckeyptr++) != -1; keynumber++ )
228             {
229                 if( pckeyptr >= endpckey )
230                 {
231                     if( (nbytes = read( fdpckey, pckeylist, PCKEYSIZ * 2)) < 0 )
232                     {
233                         perror("list can't read pckey file");
234                         return;
235                     }
236
237                     pckeyptr = pckeylist;
238                     endpckey = pckeylist + (nbytes / 2);
239                 }
240
241
242                 if( keyval < lo )
243                     continue;
244
245                 if( keyval > hi )
246                 {
247                     if( keyval < newlo )
248                         newlo = keyval;
249
250                     continue;
251                 }
252
253                 checkptr = checklist + ( keyval - lo );
254
255
256                 /****** don't bump count if cuplicate keyword in contact    */
257
258                 if( checkptr -> pcnum != pcid )
259                 {
260                     checkptr -> keycount++;
261                     checkptr -> pcnum = pcid;
262                     checkptr -> keynum = keynumber;
263                 }
264             }
265
266
267
268             keypc = pcid + 1;       /* above loop uses up keys for pcid     */
269
270         }
271
272
273         /****** if newlo has its original value return -1 = all done       */
274
275         if( newlo == 077777 )
276             return( -1 );
277         else
278             return( newlo );
279
280     }
```

```
#
#include        "structdefs.i"
#include        "commandefs.i"
#include        "params.i"



select( opcode, term)
int opcode;             /* id number of command                         */
char term[];            /* null terminated string, argument of command  */
{
    extern int phase;           /* for switching between scratch files  */
    extern int fidscratch[2];   /* file descriptors for scratch files   */
    int fidpckey;               /* descriptor for pckey file            */
    char pckeyfile[256];        /* used to build pckey file name        */
    int old;                    /* file descriptor for scratch file     */
    int new;                    /* file descriptor for scratch file     */
    char buffer[256];           /* buffer for user response             */
    char *src;                  /* utility pointer used with copy()     */
    char *dst;                  /* utility pointer used with copy()     */
    struct marker *termptr;     /* points to struct describing term     */
    int num;                    /* number of pcs from bool or keypcs    */
    int filenum;                /* category of keyword                  */
    int idnumber;               /* number of keyword in category        */
    int onepc[2];               /* buffer for writing list of one pc    */

    /****** if term is null, use current and old lists  */

    if( term[0] == 0 )
    {
        if( opcode != FIND )
        {
            /****** note that we don't change phase on this one */

            new = fidscratch[ phase ];  /* new pc list will be in phase */
            old = fidscratch[ 1 - phase];       /* out of phase         */

            num = bool(old,new,new,opcode);
            printf("%d in current list\n", num);
        }

        return;
    }

    /****** look at term[0] to see if user wants just one pc    */

    if( term[0] == '#' )
    {
        onepc[0] = atoi( term + 1 );
        onepc[1] = -1;


        phase = 1 - phase;              /* maps 0 to 1 and maps 1 to 0  */
        new = fidscratch[ phase ];      /* new pc list will be in phase */
```

```
 57          old = fidscratch[ 1 - phase];   /* old will be out of phase     */
 58
 59          seek( new, 0, 0);
 60          if( write( new, onepc, 4) < 4 )
 61          {
 62              perror("select can't write to pc list");
 63              exit();
 64          }
 65
 66
 67          printf("pc %d selected\n", onepc[0]);
 68
 69          if( opcode != FIND )
 70          {
 71              num = bool(old,new,new,opcode);
 72
 73              printf("%d in current list\n", num);
 74          }
 75          return;
 76      }
 77
 78
 79      /****** special case: user wants list of all pc's   */
 80
 81      if( compar( term, ALL) == 0 )
 82      {
 83          phase = 1 - phase;              /* maps 0 to 1 and maps 1 to 0  */ .
 84          new = fidscratch[ phase ];      /* new pc list will be in phase */
 85          old = fidscratch[ 1 - phase];   /* old will be out of phase     */
 86
 87          num = initlist( new );
 88
 89          printf("%d in current list\n", num);
 90
 91          if( opcode != FIND )
 92          {
 93              num = bool(old,new,new,opcode);
 94
 95              printf("%d in current list\n", num);
 96          }
 97          return;
 98      }
 99
100
101      /****** here is where we handle ordinary keywords   */
102
103
104      if( (termptr = keyword( term )) != 0 )
105      {
106
107          filenum = termptr -> file;
108          idnumber = termptr -> idnum;
109
110          if( filenum >= MESSAGES )
111          {
112              help(0, termptr );          /* print out message for user   */
```

```
113             return;
114         }
115
116
117         /****** reset phase to switch new and old files */
118
119         phase = 1 - phase;              /* maps 0 to 1 and maps 1 to 0  */
120         new = fidscratch[ phase ];      /* new pc list will be in phase */
121         old = fidscratch[ 1 - phase];   /* old will be out of phase     */
122
123
124
125         concat( PCKEY, locv(0, filenum), pckeyfile);
126
127         if( (fidpckey = open(pckeyfile, 0)) < 0 )
128         {
129             perror("select, pckey open");
130             return;
131         }
132
133
134
135         /****** use keypcs to get list of pcs for non-event keyword     */
136
137         num = keypcs(idnumber, fidpckey, new);
138
139
140         printf("%d found\n", num);
141
142         close( fidpckey );
143
144
145         if( opcode != FIND )
146         {
147             num = bool(old,new,new,opcode);
148
149             printf("%d in current list\n", num);
150         }
151         return;
152     }
153 }
```

```
#

#include        "structdefs.i"
#include        "params.i"

#define         LSTSIZ          256




show(fid)
int fid;                /* file descriptor of current pc list           */
{
    struct getlbuf bufin;       /* buffer for getl() routine            */
    char line[256];             /* gets lines from getl()               */
    int nbytes;                 /* char count from getl                 */
    char *key;                  /* points to keyword string             */
    int type;                   /* index to categories                  */
    int printflag;              /* flags printing first key of a type   */
    struct keymarker *markptr;  /* points thru keyptr array of pcdata   */
    extern char *keynames[];    /* names of keyword categories          */
    int keynumber;              /* counts filled in keyptr entries      */
    struct keydata pcdata;      /* picks up keyword lines for pcs       */
    char *src;                  /* utility pointer used with copy()     */
    char *dst;                  /* utility pointer used with copy()     */
    int pclist[LSTSIZ];         /* buffer for input and output lists    */
    register int j;             /* fast loop counter                    */
    register int pcid;          /* id number of source permit in lists  */
    int *pclistptr;             /* points thru list buffer              */
    int *endlist;               /* marks end of pclist array            */
    struct ndx pcindex; /* offsets of data in pc file           */
    long offset;                /* temp copy of pcindex offsets         */
    static int fidpc;           /* file descriptor for pc data file     */


    /****** make sure fidpc is closed before using again        */

    if( fidpc !=  0 )
    {
        close( fidpc );
        fidpc = 0;              /* mark it as being closed      */
    }



    seek(fid,0,0);              /* make sure we get whole file          */

    while( (j = read(fid, pclist, LSTSIZ * sizeof(*pclist))) > 0)
    {
        j =/ 2;                 /* j = number of ints read              */

        pclistptr = pclist;

        while(j--  &&  (pcid = *pclistptr++) != -1)
```

```
57          {
58
59
60              if( (fidpc = getndx( pcid, &pcindex)) < 0 )
61                  continue;
62
63              printf("pc #%d\n", pcid);
64
65
66              putdata( pcid, fidpc, pcindex.keylines, &pcdata);
67
68              for( type = 0; type < NUMTYPS; type++)
69              {
70                  printflag = 0;
71
72                  markptr = pcdata . keyptr;
73                  for( keynumber = 0; keynumber < pcdata . totkeys; keynumber++)
74                  {
75                      if( markptr -> keytype  ==  type )
76                      {
77                          if( printflag++ == 0 )
78                              printf("  \n%s:\n", keynames[ type ]);
79
80                          printf("    %s\n", markptr -> keystring);
81                      }
82                      markptr++;
83                  }
84              }
85
86              /****** now print text data */
87
88              printf("\n\n");
89
90              offset = pcindex . datalines;
91
92              if( offset < 0  ||  seekl( fidpc, offset) < 0 )
93              {
94                  printf("can't seek to data\n");
95                  continue;
96              }
97
98              bufin.fildes = fidpc;
99              bufin.nleft = 0;
100
101             while( (nbytes = getl( line, &bufin)) > 0 )
102             {
103                 line[ nbytes ] = 0;
104
105                 if( line[0] == '#' )
106                     break;
107
108                 printf("%s", line);
109             }
110
111             close( fidpc );             /* all done with this one       */
112             fidpc = 0;                  /* mark it as being closed      */
```

```
113
114                 printf("******\n\n");
115             }
116
117             if(pcid == -1)
118                 break;
119
120         }
121     }
```

```
#
/*****************************************************************************

NAME:

        lookup()

FUNCTION:

        Look in the hash table file for the word marker structs corresponding
        to a given string.

CALLING SEQUENCE:

        char *word
        int fileid
        int checkflag
        struct marker *findptr
        int max

PARAMETERS:

        word            Points to the string to be looked up in the hashtable.

        fileid          The number of the keyword file in which the word
                        should be located.  If this flag is -1, then all the
                        keyword files are searched.

        checkflag       If this flag is 0, then a struct whose 3 hash values
                        match those of the given word is assumed to match the
                        word.  If this flag is non-zero, then the keyword
                        corresponding to such a struct is read from its
                        keyword file, and compared to the given word.

        findptr         Points to an array of structs which is filled in
                        by "lookup()" with the structs which match the given
                        word.

        max             Gives the size of the above array so that "lookup()"
                        can avoid overwriting that array.

RETURNS:

        The number of struct elements matching the given word.

        If an error condition is encountered on an "open()", "seek()" or
        a "read()", then "exit()" is called to terminate the program.

ALGORITHM:

        On the first call, the hashtable file is opened and the file
        descriptor is saved in a static variable to save time on subsequent
        calls.  At this time, "fstat()" is called to determine the length
        of the hashtable file measured in marker structs.  The OVERFLOW
        parameter is subtracted from this length to determine the "modulus".
        Obviously, this parameter must agree with its counterpart in the
```

```
57          "hash" program.
58
59          To look up the given word in the hashtable, the "hashfn()" routine
60          is called to compute the 3 hash values of the word.  The index
61          into the hash table is computed from the hash values and the "moculus".
62          A calculation is performed to determine the number of structs that
63          can be read beginning with the index, that will not cross a 512 byte
64          boundary in the file.  This makes the initial read from the hash table
65          about twice as fast as if it crossed the boundary, and the first
66          read almost always encompasses the collision list.
67
68          The structs in the collision list are scrutinized to see if they
69          match the input word and those that do are copied into the array
70          of structs indicated by "findptr".  If this array runs out of room,
71          the structs are no longer copied, but the count of matching structs
72          still continues.
73
74  CALLS:
75
76          hashfn()        To compute hash values of the input word.
77
78          seekl()         To perform seeks at long offsets.
79
80          concat()        To concatenate strings. ( borrowed from CELOS )
81
82          getl()          To read keywords from the keyword files.
83
84          copy()          To extract the keywords from the line on which
85                          they are declared.
86
87          compar()        To compare strings. ( borrowed from CELOS )
88
89          Also, the following Unix calls.
90
91          open()
92          fstat()         To get the size of the hash table file.
93          read()
94          exit()
95          perror()
96          printf()
97
98  CALLED BY:
99
100         Various programs that need to look up keywords.
101
102 HISTORY:
103
104         written by Dan Putnam - fall 1978
105
106         This routine is essentially identical to the "lookup()" used in
107         the PAMS system.  The "include" files are the only major
108         difference, and this change was needed only to redefine the
109         "KEYNAME" parameter.  Adaptations were made, spring 1979, by
110         Dan Putnam.
111
112 ************************************************************************/
```

```
113
114
115  #include        "structdefs.i"
116  #include        "params.i"
117
118
119
120  #define         HASHBUFSIZ      32      /* fits in one block            */
121  #define         OVERFLOW        100
122
123  lookup(word,fileid,checkflag,findptr,max)
124  char *word;                          /* points to word we are looking for   */
125  int fileid;                          /* if -1, any file; if >= 0, specific  */
126  int checkflag;                       /* if 1, then check characters         */
127  struct marker *findptr;              /* for markers of found words          */
128  int max;                             /* length of findptr array             */
129  {
130      struct filestruct   /* used for getting length of hashtable            */
131      {
132          char jnk[9];                 /* don't need this stuff               */
133          char size0;                  /* high byte of file size              */
134          int  size1;                  /* low word of file size               */
135          char jnk2[24];               /* don't need this stuff either        */
136      } filedata;
137
138      struct              /* used to load size0 and size1 into a long         */
139      {
140          char hi_byte;                /* corresponds to size0 of filestruct  */
141          char highest;                /* high order byte of a long           */
142          int  low_word;               /* corresponds to size1 of filestruct  */
143      };
144
145      struct              /* used to access high and low words of a long      */
146      {
147          int hibits;
148          int lobits;
149      };
150
151      int num;                         /* for returning number of finds       */
152
153      register struct marker *srcptr;      /*points thru hashtable           */
154      register struct marker *dstptr;      /* for moving found markers        */
155
156      struct getlbuf bufr;             /* struct used by getl() routine       */
157      int nbytes;                      /* char count returned from getl       */
158      char filename[256];              /* for building keyword file name      */
159      char keyline[256];               /* for reading line from keyword file  */
160      char keystring[256];             /* gets keyword string out of keyline  */
161      char *src;                       /* used with copy routine              */
162      char *dst;                       /* used with copy routine              */
163      long index;                      /* index into hashtable                */
164      long boundary;                   /* 512 byte boundary after index       */
165      register int readbytes;          /* bytes in markers up to boundary     */
166      int hashval[3];                  /* hash values                         */
167
168      struct marker hashbuf[HASHBUFSIZ];  /* buffer for hashtable             */
```

```
169         struct marker *endbuf;              /* end of markers in hashbuf    */
170         int evenword;                /* number of bytes in hashbuf          */
171
172         static int fidhash;                 /* descriptor of hashtable      */
173         static long modulus;                /* modulus for hash algorithm   */
174
175
176
177
178         /****** first call initialization   */
179
180         if( fidhash == 0 )
181         {
182             if( (fidhash = open( HASHTBL, 0) ) < 0 )
183             {
184                 perror("lookup, can't open hashtable");
185                 exit();
186             }
187
188
189             /****** get size of hashtable to compute modulus        */
190
191             fstat( fidhash, &filedata);
192
193             modulus = 0;
194             modulus.hi_byte = filedata.size0;
195             modulus.low_word = filedata.size1;      /* size of hashtable    */
196             modulus =/ sizeof( *hashbuf );  /* number of keyword markers    */
197             modulus =- OVERFLOW;
198
199         }
200
201
202         /****** compute hash values of word and look into hashtable */
203
204         hashfn(word, hashval);
205
206
207         index.lobits = hashval[0];
208         index.hibits = hashval[1] & 0077777;
209
210
211         index = index % modulus;
212         index =* sizeof( *hashbuf );
213
214         /****** compute number of bytes from index to 512 byte boundary     */
215
216         readbytes = 512 - ( index.low_word & 0777);
217
218         readbytes = (readbytes / sizeof( *hashbuf ) ) * sizeof( *hashbuf );
219
220         if( readbytes > sizeof( hashbuf )  ||  readbytes == 0 )
221             readbytes = sizeof( hashbuf );
222
223
224
```

```
225         if(seekl(fidhash,index) < 0)
226         {
227             printf("failed on seek into hashtable\n");
228             exit();
229         }
230
231
232         /****** look at hashtable entries until an empty slot is found      */
233
234         num = 0;            /* none found so far                            */
235         dstptr = finoptr;   /* copy to register pointer for extra speed     */
236
237         while( (nbytes = read( fidhash, hashbuf, readbytes)) > 0 )
238         {
239             readbytes = sizeof( hashbuf );  /* next time fill buffer        */
240
241             endbuf = hashbuf + (nbytes / sizeof( *hashbuf ) );
242
243             for( srcptr = hashbuf; srcptr < endbuf; srcptr++)
244             {
245                 /****** first check to see if empty */
246
247                 if( srcptr -> file == -1 )
248                 {
249                     return( num );.          /* thats all folks             */
250                 }
251
252
253                 if( srcptr -> hashv[0] != hashval[0] )
254                     continue;                          /* not found         */
255
256                 if( srcptr -> hashv[1] != hashval[1] )
257                     continue;                          /* not found         */
258
259                 if( srcptr -> hashv[2] != hashval[2] )
260                     continue;                          /* not found         */
261
262
263                 if( fileid >= 0  &&  srcptr -> file != fileid )
264                     continue;       /* not in the right file               */
265
266
267                 if( checkflag )
268                 {
269                     /****** check strings to be absolutely sure     */
270
271                     concat(KEYNAME, locv(0, srcptr -> file), filename);
272
273
274                     if( (bufr.fildes = open( filename, 0)) < 0 )
275                     {
276                         perror("lookup can't open keyword file");
277                         exit();
278                     }
279
280                     bufr.nleft = 0;
```

```
281
282                     if( seekl( bufr.fildes, srcptr -> beginbyte ) < 0 )
283                     {
284                         perror("lookup can't seek to keyword");
285                         exit();
286                     }
287
288
289                     if( (nbytes = getl(keyline, &bufr)) < 0 )
290                     {
291                         printf("lookup can't read keyword file\n");
292                         exit();
293                     }
294
295                     close( bufr.fildes );
296                     keyline[nbytes - 1] = 0;
297                     src = keyline + 1;
298                     dst = keystring;
299                     copy( &src, &dst, ':', 256);
300
301                     if( compar( keystring, word) != 0 )
302                         continue;           /* no match                    */
303                 }
304
305
306                 if( num++ < max )
307                 {
308                     dstptr -> hashv[0] = srcptr -> hashv[0];
309                     dstptr -> hashv[1] = srcptr -> hashv[1];
310                     dstptr -> hashv[2] = srcptr -> hashv[2];
311                     dstptr -> file = srcptr -> file;
312                     dstptr -> idnum = srcptr -> idnum;
313                     dstptr -> beginbyte = srcptr -> beginbyte;
314                     dstptr++;
315                 }
316             }
317         }
318
319         printf("bad read in lookup, index = %D readbytes = %d\n",index,readbytes);
320     }
321
```

```
#
/*****************************************************************************

NAME:

        help()

FUNCTION:

        Print any lines following the line which declares a keyword in
        a keyword file.

CALLING SEQUENCE:

        int fid
        struct marker *termptr

PARAMETERS:

        fid             File descriptor for output messages.  Set to 1
                        for output to the user's terminal.

        termptr         Points to a word marker struct identifying a given
                        keyword.

RETURNS:

        nothing.

ALGORITHM:

        The routine examines "termptr" and returns immediately if it is
        a null pointer.  Otherwise, the category number is appended to
        the keyword file prefix and the keyword file is opened.  The offset
        stored in the marker is used to seek into the keyword file.
        Note that 1 is added to the offset to skip over the '#' character
        which marks the keyword.  This line is not printed, but subsequent
        lines are printed until a line beginning with '#' is found or
        until the end of file.

CALLS:

        concat()
        seekl()
        getl()

        Also, Unix calls:

        open()
        perror()
        write()
        close()

CALLED BY:

        iicep()
```

```
57          select()
58
59  HISTORY:
60
61          written by Dan Putnam - fall 1978 - for PAMS system.
62          Adapted for use by the IICEP system - spring 1979 - by changing the
63          "include" files to define the "KEYNAME" parameter differently.
64
65
66  ******************************************************************************/
67
68
69
70  #include        "structdefs.i"
71  #include        "params.i"
72
73
74  help(fid, termptr )
75  int fid;                                /* descriptor of output file    */
76  struct marker *termptr;                 /* describes keyword            */
77  {
78      char filename[80];
79      char line[80];                      /* input line from file         */
80      struct getlbuf buffer;              /* used by getl routine         */
81      int nchars;                         /* number of chars in line      */
82      int linecount;                      /* number of lines printed      */
83
84
85      if( termptr == 0 )
86      {
87          /****** nothing to print       */
88
89          return;
90      }
91
92
93      concat(KEYNAME,locv(0,termptr->file), filename);
94      if( (buffer.fildes = open(filename,0)) < 0)
95      {
96          perror("help, can't open");
97          return;
98      }
99
100
101     buffer.nleft = 0;
102     if( seekl(buffer.fildes,termptr->beginbyte + 1) < 0 )
103     {
104         perror("help, can't seek to keyword\n");
105         close(buffer.fildes);
106         return;
107     }
108
109     linecount = 0;
110     while( (nchars = getl( line, &buffer )) > 0  &&  line[0] != '#')
111     {
112         if( linecount++ == 0 )
```

```
113                 continue;           /* skip over first line                 */
114
115             line[nchars] = 0;       /* insert null after the end-of-line.   */
116
117             write(fid, line, nchars);
118         }
119
120         close(buffer.fildes);
121     }
```

```
#
/*************************************************************  ********************

NAME:

        iam()

FUNCTION:

        Create a unique name which can be concatenated with scratch file
        names to prevent multiple instances of a program from overwriting
        each others scratch files.

CALLING SEQUENCE:

        char *me
        int iam()

PARAMETERS:

        me - points to a character buffer of at least 3 characters.
        This buffer receives the unique name, which consists of a lower
        case letter, followed by a "#" character and a null character.

RETURNS:

        positive integer        if name creation was successful.

        negative integer        otherwise.

ALGORITHM:

        The routine uses the "creat" system call to attempt to create
        a file named with the string "me".  The "creat" fails if a file
        already exists with this name and does not have write access.
        If this occurs, then the name is altered and the process continues
        until a unique name is found or else the lower case pre-fixes have
        been exhausted.  In the latter case, -1 is returned to signify
        failure in creating the unique name.  When the procedure succeeds
        in creating a unique name, the file opened by iam() is closed
        before returning.  It is not expected that this file will be
        used for anything except to mark its name as already being in use.

CALLS:

        creat()         Unix system call to create files.

CALLED BY:

        usually a main program.

HISTORY:

        written by Dan Putnam - fall 1978

*************************************************************************************/
```

```
57
58
59
60  iam(me)
61  char *me;
62  {
63      int i;
64      int fid;
65      me[0] = 'a';
66      me[1] = 'a';
67      me[2] = 0;
68      for(i = 0; i < 26; i++)
69      {
70          if( (fid = creat(me,0444)) < 0)
71          {
72              me[0]++;
73          }
74          else
75          {
76              close(fid);
77              return(fid);
78          }
79      }
80
81      return(fid);
82  }
```

```
    1   /*                      C O N C A T  (Note: Borrowed from CELDS, Thanx! )
    2    *
    3    *      Concatenate two strings into one string.  Concat returns a
    4    * pointer to the end of the resultant string so that successive calls
    5    * to concat may be made easily.
    6    *
    7    * Arguments:    first           pointer to first string
    8    *               second          pointer to second string
    9    *               result          pointer to end of resulting string
   10    *
   11    * Returns:      pointer to end of result string
   12    *
   13    * Calls:        none
   14    */
   15
   16   char   *concat (first, second, result) char    *first,
   17                                                  *second,
   18                                                  *result;
   19   {
   20           while (*result++ = *first++);          /*  Copy first string to result  */
   21           --result;                              /*  Back up over nul  */
   22           while (*result++ = *second++);         /*  Copy second string to result  */
   23           --result;                              /*  Back up over nul  */
   24           return (result);
   25   }
```

```
#
/*****************************************************************************

NAME:

        copyfile()

FUNCTION:

        Copy the contents of one open file to another.

CALLING SEQUENCE:

        int fidin
        int fidout

PARAMETERS:

        fidin           File descriptor of source file opened for reading.

        fidout          File descriptor of destination file opened for writing.

RETURNS:

        nothing.

ALGORITHM:

        The routine first seeks to the start of both files in case other
        procedures have used the file descriptors.  Then the routine reads
        from the source file in a loop and writes the same number of bytes
        to the destination as it read.

CALLS:

        Unix calls:

        seek()
        read()
        write()
        perror()

CALLED BY:

        pams ( main program )
        restore()
        save()

HISTORY:

        written by Dan Putnam - fall 1978

*****************************************************************************/
```

```
57  copyfile( fidin, fidout)
58  int fidin;                      /* descriptor of source file          */
59  int fidout;                     /* descriptor of destination file     */
60  {
61      int nbytes;
62      char buffer[512];
63
64      seek( fidin, 0, 0);                 /* from beginning             */
65      seek( fidout, 0, 0);                /* from beginning             */
66      while( (nbytes = read( fidin, buffer, 512)) > 0 )
67      {
68          if( write( fidout, buffer, nbytes) < nbytes )
69          {
70              perror("save write error");
71              close( fidout );
72              return;
73          }
74      }
75
76
77      if( nbytes < 0 )
78      {
79          perror("copyfile, read error");
80      }
81  }
```

```
#
/*****************************************************************************

NAME:

        resp()

FUNCTION:

        Get a line of user response form the terminal.

CALLING SEQUENCE:

        char *bfr
        int resp()

PARAMETERS:

        bfr             Points to buffer for user response.

RETURNS:

        Returns the number of characters in the response exclusive of '\r',
        or returns -1 on end-of-file.

ALGORITHM:

        The routine works with a built in limit of 80 characters per response.
        Characters are read from the terminal until either 80 are read or
        an end-of-line or end-of-file is encountered.  If the last character
        is an end-of-line, then it is overwritten with a null.

CALLS:

        nothing.

CALLED BY:

        pams ( main program )
        select()
        keyword()
        list()
        gateff()
        getsmons()

HISTORY:

        written by Dan Putnam - fall 1978

*****************************************************************************/


#define         MAXCHR  80      /* maximum response length              */


resp(bfr)
```

```
57    char *bfr;              /* character buffer for user response          */
58    {
59        register int countdown;
60        register int chr;
61        register char *ptr;
62
63
64        countdown = MAXCHR;
65        ptr = bfr;
66
67        do
68        {
69            *ptr++ = chr = getchar();
70
71
72            if( chr == '\0' )
73                return( -1 );
74
75        }
76        while(--countdown  &&  chr != '\n');
77
78        if(chr != '\n')
79        {
80            while(getchar() != '\n');       /* flush input                 */
81            *ptr = 0;
82        }
83        else
84        {
85            *(--ptr) = 0;                   /* replace CR by null          */
86        }
87
88        return( ptr - bfr );
89
90    }
```

```
#
/*****************************************************************************

NAME:

        copy()

FUNCTION:

        Move characters from one string to another and update pointers
        to source and destination for subsequent calls.

CALLING SEQUENCE:

        char **source
        char **dest
        char delimiter
        int maxchars

PARAMETERS:

        source is the address of a pointer to the source character string.
        this pointer is updated to point past the last character moved.

        dest is the address of a pointer to the destination string.
        This pointer is left pointing past the null character terminating
        the string that was moved.

        delimiter is the character signalling the end of the source string.
        If this character is not encountered, a null character will halt
        the transfer of characters.

        maxchars is the size of the destination string.  If there are
        more characters to be moved than maxchars, a -1 is returned
        and copy does not overwrite the end of the buffer.

RETURNS:

        -1      if the size limitation given by maxchars can not be met.

        otherwise copy returns the number of characters moved including
        the null character terminating the destination string.

ALGORITHM:

        The copy routine skips over leading blank or tab characters.
        Embedded substrings of blanks or tabs in the source string
        are condensed to one blank.  The transfer of characters stops
        when the delimiter character or a null character is encountered
        or when the size limitation given by maxchars is met.
        The source pointer is never moved past a null character.
        In this case, subsequent calls to copy move an empty string.
        If the delimiter is not null and it is encountered before a null,
        then the source pointer is moved past the delimiter.
        Thus, successive calls can move substrings separated by the delimiter.
        The destination string is null terminated and the destination
```

```
57          pointer is left pointing past the null.  Thus, repeated calls
58          to copy can move strings into a shared buffer.
59
60  CALLS:
61
62          nothing
63
64  CALLED BY:
65
66          all kinds of procedures that move strings around.
67
68  COMMENTS:
69
70          copy() can be used for several different purposes:
71
72          1. cleaning a string to eliminate extra blanks or tabs.
73
74          2. parsing a line into fields.
75
76          3. counting the number of fields on a line.
77
78  HISTORY:
79
80          written by Dan Putnam - fall 1978
81
82  ***************************************************************************/
83
84
85  copy(source, dest, delimiter, maxchars)
86  char **source;                  /* points to a pointer to source string */
87  char **dest;                    /* points to pointer to destination     */
88  char delimiter;                 /* stop copying when this char is found */
89  int maxchars;                   /* size of destination                  */
90  {
91      register char *src;         /* copy of source for speed, esthetics  */
92      register char chr;          /* temp for *src to save indirection    */
93      register int slack;         /* room left in destination             */
94      char *dst;                  /* points to destination                */
95      int ret;                    /* return value                         */
96
97
98
99      src = *source;
100     dst = *dest;
101     slack = maxchars;           /* available room                       */
102
103     if(slack <= 0)
104     {
105         return( -1 );
106     }
107
108
109     /***** first throw away leading blanks and tabs *********/
110
111     while(*src == ' '  ||  *src == '\t')
112         src++;
```

```
113
114
115
116         /***** now run through the rest of the string ********/
117
118         do
119         {
120             if( (chr = *src) == 0 )
121                 break;
122
123             src++;                              /* not null, so move on          */
124
125             if( chr == delimiter )
126                 break;
127
128
129             if(chr == ' '  ||  chr == '\t')          /* if blank or tab       */
130             {
131                 while( (chr = *src) == ' '  ||  chr == '\t' )
132                     src++;
133
134
135                 if( chr == 0 )
136                     break;
137
138
139                 if( chr == delimiter )
140                 {
141                     src++;                      /* move past delimiter           */
142                     break;
143                 }
144
145
146                 chr = ' ';
147             }
148
149             *dst++ = chr;
150
151         }while( --slack );
152
153
154         if( slack > 0 )
155         {
156             ret = maxchars - slack + 1;
157         }
158         else
159         {
160             /****** looks like we didn't find the end but ran out of room    */
161
162             --dst;
163             ret = -1;
164
165             /****** move src past delimiter or up to null byte       */
166
167             while( (chr = *src) != delimiter  &&  chr != 0 )
168                 src++;
```

```
169
170             if(chr != 0)
171                 src++;
172
173         }
174
175         *dst++ = 0;                 /* leave dst pointing past null byte    */
176
177         *source = src;
178         *dest = dst;
179         return( ret );
180     }
```

```
    1   /*                      E X E C U T E  (Note: Borrowed from CELDS, Thanx! )
    2    * execute - send a string to sh to be executed
    3    *
    4    * execute ( command ) ;  char *command ;
    5    *
    6    * Forks off a process to execl the shell with a one-line
    7    * command in the string "command".  Waits for return of
    8    * the child process.
    9    *
   10    * Signals are set up so quits will interrupt the child
   11    * process, not the parent.
   12    *
   13    * Calls: fork, signal, execl, wait
   14    * Globals: none
   15    * Last modification: 31 mar 77
   16    *
   17    */
   18
   19   execute (command) char *command;
   20   {
   21           register int    child,
   22                           signalstatus;
   23           int     waitstatus;
   24
   25           if ((child = fork ()) < 0)              /* Set up the fork */
   26                   return (-1);
   27
   28   /* The child does the execl using the argument string */
   29           if (child == 0) {
   30                   signal (2, 0);
   31                   execl ("/bin/sh", "sh", "-c", command, 0);
   32           }
   33
   34           signalstatus = signal (2, 1);
   35           while (wait (&waitstatus) != child);    /* Wait for child */
   36           signal (2, signalstatus);
   37
   38           return (0);
   39   }
```

```
#
/*****************************************************************************

NAME:

        table()

FUNCTION:

        To look up a character string in an array of string pointers.

CALLING SEQUENCE:

        char *string
        char **ptrarray
        int table()

PARAMETERS:

        string - points to a null terminated string of characters.

        ptrarray - points to a null terminated array of character pointers.

RETURNS:

        -1      if the string is not found in the array of pointers.

        otherwise table() returns the index of the first pointer
        in the array pointing to an identical string.

EXAMPLE:

        Define "name" and "nametable" as follows:

        char *name      "jody";

        char *nametable[]
        {
                "fred",
                "jody",
                "pat",
                0
        };

        Then the call "table( name, nametable)" returns 1 to incicate
        that "nametable[1]" points to the same string as "name".
        However, "table( "joe", nametable )" returns -1, since "joe"
        is not listed in "nametable".

ALGORITHM:

        The "ptrarray" is searched sequentially, and if a pointer in the
        array points to a string agreeing with that indicated by the
        "string" argument, then "table" returns the index of that element
        in the array.  If a null pointer is found in the array, then -1
        is returned.
```

```
57
58  CALLS:
59
60          compar()        A routine borrowed from CELDS to test whether
61                          string pointers point to identical strings.
62
63  CALLED BY:
64
65          usually routines that need to parse command strings or check
66          for "legal" values of string variables from among those in a
67          small, pre-defined list.
68
69  HISTORY:
70
71          written by Dan Putnam - fall 1978
72
73  ***************************************************************************/
74
75
76  table(string,ptrarray)
77  char *string;                   /* pts at null terminated string        */
78  char **ptrarray;                /* pts at null term array of char ptrs  */
79  {
80      register char **ptrptr;     /* copy of ptrarray for speed           */
81      register char *ptr;         /* copy of *ptrptr for speed            */
82      register int i;             /* fast loop counter                    */
83
84
85      ptrptr = ptrarray;
86      for(i = 0; (ptr = *ptrptr++); i++)
87      {
88          if(compar(string,ptr) == 0)
89              return(i);
90      }
91
92      return(-1);
93  }
```

```
#
/*****************************************************************************

NAME:

        save()

FUNCTION:

        Save the contents of the current scratch file of id numbers in
        a file named by the input character string.

CALLING SEQUENCE:

        char *filename

PARAMETERS:

        filename        Points to the string naming the output file.

RETURNS:

        nothing.

ALGORITHM:

        The routine attempts to create a file named by the "filename"
        argument.  If this attempt fails, the routine prints a message
        to that effect and returns.  If it succeeds, then the "copyfile()"
        routine is used to copy the contents of the current scratch file
        to the file which has been created.

CALLS:

        copyfile()

        Also, Unix calls:

        creat()
        seek()
        perror()

CALLED BY:

        pams ( main program )

HISTORY:

        written by Dan Putnam - fall 1978

*****************************************************************************/


save( filename )
char filename[];                /* string naming output file            */
```

```
57  {
58      extern int phase;
59      extern int fidscratch[2];
60      int fidin;
61      int fidout;
62
63      fidin = fidscratch[ phase ];
64      seek( fidin, 0, 0 );
65
66
67      if( (fidout = creat( filename, 0666)) < 0 )
68      {
69          perror("save can't create file");
70          return;
71      }
72
73      copyfile( fidin, fidout );
74
75  }
```

```
#
/*****************************************************************************

NAME:

        restore()

FUNCTION:

        Restore a list of data accession numbers to current status.

CALLING SEQUENCE:

        char *filename

PARAMETERS:

        filename        Points to string naming the file of accession numbers.
                        If filename points to a null string, then the previous
                        list is restored to current status.

RETURNS:

        nothing.

ALGORITHM:

        The "filename" parameter is checked to see if it points at a null
        string. If so, then the global "phase" variable is reset to switch
        the scratch files. If the "filename" parameter points at a non-null
        string, then the routine attempts to open the file.  If the open
        is successful, then "phase" is reset and "copyfile()" is called
        to copy the contents of the input file into the current file.

CALLS:

        copyfile()

        Also, Unix calls:

        open()
        perror()

CALLED BY:

        pams ( main program )

HISTORY:

        written by Dan Putnam - fall 1978

*****************************************************************************/


restore( filename )
```

```
57  char filename[];                        /* names file to be read in.    */
58  {
59      extern int phase;                   /* for switching scratch files  */
60      extern int fidscratch[2];           /* scratch file descriptors     */
61      int fidin;                          /* descriptor for restored file */
62      int fidout;                         /* copy of scratch descriptor   */
63
64
65      if( *filename == 0 )
66      {
67          /****** phase switch effectively restores old list      */
68
69          phase = 1 - phase;
70          return;                         /* that's all there is to it    */
71      }
72
73
74      if( (fidin = open( filename, 0)) < 0 )
75      {
76          perror("restore can't open file");
77          return;
78      }
79
80      phase = 1 - phase;                  /* switch scratch files         */
81
82
83      fidout = fidscratch[ phase ];       /* write to in-phase file       */
84
85      copyfile( fidin, fidout);
86  }
```

```
#
/*****************************************************************************

NAME:

        peek()

FUNCTION:

        Invoke the editor on the keyword file corresponding to the
        category name given by the input argument string.

CALLING SEQUENCE:

        char *category

PARAMETERS:

        category        String naming the category that the user wants
                        to inspect.

RETURNS:

        nothing.

ALGORITHM:

        The routine begins by checking to see that "category" matches
        an entry in the "keynames" array.  The index of a matching
        string in that array is the keyword file number of the corresponcing
        file of keywords.  This number is appended to the keyword file
        prefix and the editor is invoked on this file using "execute()".

CALLS:

        table()
        concat()
        execute()

        Also, Unix routines:

        locv()

CALLED BY:

        pams ( main program )

HISTORY:

        written by Dan Putnam - fall 1978

*****************************************************************************/


peek( category )
```

```
57   char *category;                    /* name of a keyword category          */
58   {
59       char command[80];              /* argument string for execute routine */
60       extern char *keyprefix;        /* keyword file name prefix            */
61       extern char *keynames[];       /* names of categories                 */
62       int num;                       /* category number                     */
63
64       if( (num = table(category, keynames)) < 0 )
65       {
66           printf("'%s' is not a keyword category\n", category);
67           return;
68       }
69
70
71       concat( "ed ", keyprefix, command);
72       concat( command, locv(0,num), command );
73
74       execute( command );
75   }
```

```
#
/*****************************************************************************

NAME:

        keyword()

FUNCTION:

        Lookup a string and prompt for correct category in case of duplicates.

CALLING SEQUENCE:

        char *term
        struct marker *keyword();

PARAMETERS:

        term            Points to the string to be looked up.


RETURNS:

        keyword()       Points to a marker struct which contains data on the
                        string which has been looked up.

ALGORITHM:

        Most of the work is done by the "lookup()" routine; this routine
        is primarily just a user interface to "lookup()".  A call to
        "lookup()" is performed with the parameters set to find all
        occurences of the string in the database and check the spelling
        character for character.  If no instances are found, then a message
        to that effect is printed and a zero pointer is returned.
        If more than one instance is found, the user is prompted to
        name which category he wants.  A pointer to the appropriate
        marker struct is returned.

CALLS:

        lookup()
        resp()

CALLED BY:

        letter()
        pams ( main program )
        select()

HISTORY:

        written by Dan Putnam - fall 1978

*****************************************************************************/


```

```
 57  #include        "structdefs.i"          /* marker decl  */
 58  #define         MAXFIND         50              /* found array size     */
 59
 60  keyword(term)
 61  char *term;                             /* lookup this term             */
 62  {
 63      extern char *keynames[];            /* names of keyword categories  */
 64      char buffer[80];                    /* for getting user response    */
 65      int index;                          /* loop control: found words    */
 66      int filenum;                        /* file number of a found word  */
 67      static struct marker copylist[MAXFIND];     /* identical copies     */
 68      int copies;                         /* counts number of copies      */
 69
 70
 71
 72
 73      /******* lookup: any category, check strings                   */
 74      copies = lookup(term, -1, 1, copylist, MAXFIND);
 75
 76
 77      /****** if copies > 1, prompt for correct category             */
 78
 79      if( copies <= 0 )
 80      {
 81          printf("can't find '%s'\n", term);
 82          return(0);
 83      }
 84
 85      if( copies == 1 )
 86      {
 87          index = 0;              /* copylist[0] points to the only find  */
 88      }
 89      else
 90      {
 91          /****** prompt for the correct category        */
 92
 93          printf("Which category?\n");
 94
 95          for(;;)
 96          {
 97              for(index = 0; index < copies; index++)
 98              {
 99                  filenum = copylist[ index ] . file;
100                  printf("%d: %s\n", index + 1, keynames[ filenum ]);
101              }
102
103              resp( buffer );
104
105              index = atoi( buffer ) - 1;
106
107              if( index >= 0  &&  index < copies )
108                  break;                          /* a valid response     */
109
110          }
111      }
112
```

```
113
114         return( &copylist[ index ] );
115     }
```

```
#
/*****************************************************************************

NAME:

        hashfn()

FUNCTION:

        Convert a null-terminated character string to a 3-word array
        of integer hash values.

CALLING SEQUENCE:

        char *string
        int *hashout

PARAMETERS:

        string - points to null-terminated string to be hashed.

        hashout - points to output array of 3 hash values.

RETURNS:

        nothing.

ALGORITHM:

        One pass is made through the string for each of the 3 output
        hash values.  On a given pass, hashfn() treats the characters
        in the input string as 5, 6, or 7 bit strings, respectively.
        This is accomplished by masking off the appropriate number of
        high order bits in each character ( i.e. 3, 2, or 1 ).
        The algorithm effectively treats the input string as a bit
        string, which it "wraps around" the output hash value integer.

        The routine initializes the hash values to zero and processes
        the input characters until the null terminator is encountered.
        As each input character is considered, the low order bits
        are exclusive-ored into the hash value after being shifted
        past the bits from the previous character.  If this results
        in losing bits off the end of the integer, the lost bits
        are exclusive-ored onto the low order bits.

        For example, when the first hash value is computed, the
        first three characters of a string contribute their low order
        5 bits to give the low order 15 bits of the integer hash value.
        The low order 5 bits of the next character are exclusive-ored
        into the output integer as follows.  The low order bit is
        exclusive-ored onto the remaining high bit of the integer, and
        the next 4 bits are exclusive-ored onto the first 4 bits of the
        integer.  The fifth character is shifted into place beginning
        with the fifth bit of the output integer.

CALLS:
```

```
 57
 58          nothing.
 59
 60  CALLED BY:
 61
 62          hash            The program which creates the hashtable file.
 63
 64          lookup()        The routine used to look up terms in the keyword
 65                          files.
 66
 67  HISTORY:
 68
 69          written by Dan Putnam - fall 1978
 70
 71  COMMENTS:
 72
 73          The three hash values generated by this routine virtually
 74          identify strings uniquely.  The three hash values are essentially
 75          orthogonal in the sense that if two terms collide under one
 76          of the hash functions, there is no increased likelyhood that
 77          they will collide under either of the other two.
 78
 79          In a file of about 13,000 english words, no two words were
 80          found that collided under both of the first two hash functions.
 81          When the third function is also considered, it seems virtually
 82          assured that if two terms agree in all three hash values, then
 83          the two words are identical.  If it is assumed that the bit patterns
 84          of the hash values are random, it may be computed that the chances
 85          of finding a collision in a collection of 10,000 words is less
 86          than one in a million.
 87
 88
 89  ************************************************************************/
 90
 91
 92
 93
 94  int maskarray[]
 95  {
 96          037,
 97          077,
 98          0177,
 99  };
100
101  int nbitarray[]
102  {
103          5,
104          6,
105          7,
106  };
107
108  hashfn(string, hashout)
109  char *string;                       /* string to be hashed          */
110  int *hashout;                       /* 3 word output array          */
111  {
112      register int numbits;           /* number of bits usec in hash  */
```

```
113         int mask;                           /* masks low numbits          */
114         char *cpt;                          /* points thru string         */
115         register int chr;                   /* temp copy of *cpt          */
116         register int shift;                 /* shift chr by this many bits*/
117         int hashv;                          /* gets hash value            */
118         int i;                              /* loop control: 3 hash values*/
119
120
121         for( i = 0; i < 3; i++)
122         {
123             mask = maskarray[i];
124             numbits = nbitarray[i];
125             hashv = 0;
126             shift = 0;
127             cpt = string;
128             while(chr = *cpt++)
129             {
130
131                 chr =% mask;                        /* remove unwanted bits */
132                 hashv =^ (chr << shift);            /* shift into place     */
133                 shift = (shift + numbits) & 017;    /* =+ numbits mod 16    */
134
135                 if(numbits > shift)             /* if we wrap around word   */
136
137                     hashv =^ (chr >> (numbits - shift));
138             }
139
140             hashout[i] = hashv;
141
142         }
143     }
```

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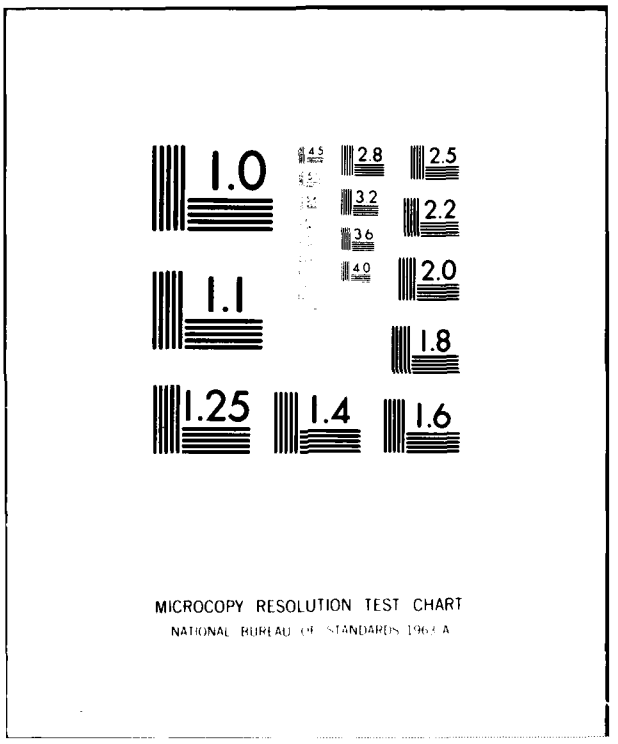
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```
#
/*****************************************************************************

NAME:

        seekl()

FUNCTION:

        Perform seeks into files with long offsets.

CALLING SEQUENCE:

        int fid
        long offset

PARAMETERS:

        fid is the file descriptor of an open file.

        offset is the offset from the beginning of the file to which
        seekl() will seek.

RETURNS:

        returns the same value as the seek() system call returns to seekl().
        -1 signals an error condition.

ALGORITHM:

        seekl() tests offset to see if the seek can be performed as an
        ordinary short integer seek.  If not, then seekl() first seeks
        by blocks ( 512 bytes ) and then seeks the rest of the way by
        bytes.

CALLS:

        seek() - Unix system call.

CALLED BY:

        all kinds of routines that read from random locations in large files.

HISTORY:

        written by Dan Putnam - fall 1978

*****************************************************************************/


seekl(fid, offset)
int  fid;
long offset;
{
    struct              /* for accessing hi and lo words of offset      */
```

```
57      {
58          int hi;
59          int lo;
60      };
61
62      register int code;          /* return code from seek
63      register int i;
64
65      if(offset.hi != 0)
66      {
67          if( (code = seek(fid, (i = offset / 512), 3)) < 0)
68          {
69              return(code);
70          }
71
72          else
73              return(seek(fid, (i = offset % 512), 1));
74      }
75      else
76          return(seek(fid, offset.lo, 0));
77  }
```

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```
 1  /*                      C O M P A R    (Note: Borrowed from CELDS, Thanx! )
 2   * compar two null-terminated strings
 3   *
 4   * The characters at "s1" and "s2" are compared until one terminates.
 5   * If the last characters compared are equal, zero is returned;
 6   * if the char from "s1" is > "s2", a positive value is returned,
 7   * otherwise a negative value.
 8   *
 9   * Calls: none
10   * Globals: none
11   * Last modification: 31 mar 77
12   *
13   */
14  int     compar (s1, s2) char    *s1,
15                                  *s2;
16  {
17          register char   *p,
18                          *q;
19          register int    greater;
20
21          p = s1;
22          q = s2;
23          while ((greater = *p - *q++) == 0 && *p++ != 0);
24          return (greater);
25  }
```

```
#
/*****************************************************************************

NAME:

        bool()

FUNCTION:

        Perform Boolean operations on files.

CALLING SEQUENCE:

        int fida
        int fidb
        int fidc
        int opcode
        int bool()

PARAMETERS:

        fida            File descriptor of the first argument file.

        fidb            File descriptor of the second argument file.

        fidc            File descriptor of the output file.

        opcode          Specifies the operation to be performed:

                                1 - file(a) AND file(b)
                                2 - file(a) OR file(b)
                                3 - file(a) EXCEPT file(b)

RETURNS:

        Returns the number of items listed in the output file.

ALGORITHM:

        The input files are read and their contents are used as indices
        into the "check" array.  Bits are set in the "check" array elements
        to indicate whether a given entry is present in either or both
        of the input files.

        When the above step is completed, a pass is made through the
        check array.  The index of a "check" array element is written to
        the output buffer depending on its membership in the input files
        and the value of the "opcode".

                AND             belongs to file(a) and to file(b).
                OR              belongs to file(a) or to file(b) or both.
                EXCEPT          belongs to file(a) but not to file(b).


        Note:  The "check" array is an array of SPMAX characters, where
        SPMAX is currently defined at 5000.  This parameter should
```

```
57          be large enough for some time to come, and could be set still
58          higher without exceeding core limitations.  However, somebody
59          probably ought to rewrite this routine so that it loops to
60          write the output file in segments.  That is, the routine would
61          make a complete pass through both input files in each iteration.
62          Only those values in the current segment range would be marked
63          in the "check" array.
64
65  CALLS:
66
67          Unix calls:
68
69          seek()
70          read()
71          write()
72
73  CALLED BY:
74
75          select()
76
77  HISTORY:
78
79          written by Dan Putnam - fall 1978
80
81  ************************************************************************/
82
83
84  #define         AND             1
85  #define         OR              2
86  #define         EXCEPT          3
87  #define         MASKA           01
88  #define         MASKB           010
89
90  #define         SPMAX           5000
91  #define         LSTSIZ          256
92
93  bool(fida,fidb,fidc,opcode)
94  int fida;                       /* file descriptor of first operand     */
95  int fidb;                       /* file descriptor of second operand    */
96  int fidc;                       /* file descriptor of resultant         */
97  int opcode;                     /* AND, OR or EXCEPT                    */
98  {
99      char check[SPMAX];          /* check list for membership in lists   */
100     int list[LSTSIZ];           /* buffer for input and output lists    */
101     register int j;             /* fast loop counter                    */
102     register char *checkptr;    /* points thru check array              */
103     register int spid;          /* id number of source permit in lists  */
104     int *listptr;       /* points thru list buffer              */
105     int *endlist;               /* marks end of list array              */
106     int maxa;                   /* max sp id in file a                  */
107     int maxb;                   /* max sp id in file b                  */
108     int maxc;                   /* upper bound of elements in result    */
109     int count;                  /* for returning size of resultant file */
110
111
112     /****** first, clear check array    */
```

```
113
114         checkptr = check;
115         j = SPMAX;
116         do
117             *checkptr++ = 0;
118         while(--j);
119
120
121
122
123         /****** run thru file a checking sp's found in list                */
124
125         seek(fida,0,0);             /* make sure we get whole file         */
126         maxa = -1;                  /* init to find max in file a          */
127
128         while( (j = read(fida, list, LSTSIZ * sizeof(*list))) > 0)
129         {
130             j =/ 2;                 /* j = number of ints read             */
131
132             listptr = list;
133
134             while(j--  &&  (spid = *listptr++) != -1)
135             {
136                 maxa = maxa > spid ? maxa : spid;
137
138                 check[spid] =| MASKA;
139             }
140             if(spid == -1)
141                 break;
142
143         }
144
145
146         /****** run thru file b checking sp's found in list          */
147
148         seek(fidb,0,0);             /* make sure we get whole file         */
149         maxb = -1;                  /* init to find max in file b          */
150
151         while( (j = read(fidb, list, LSTSIZ * sizeof(*list))) > 0)
152         {
153             j =/ 2;                 /* j = number of ints read             */
154
155             listptr = list;
156
157             while(j--  &&  (spid = *listptr++) != -1)
158             {
159                 maxb = maxb > spid ? maxb : spid;
160
161                 check[spid] =| MASKB;
162             }
163             if(spid == -1)
164                 break;
165
166         }
167
168         /****** now run thru the check array to get output file            */
```

```
169
170         listptr = list;
171         endlist = list + LSTSIZ;
172         checkptr = check;
173         seek(fidc,0,0);                 /* start at the beginning of the file   */
174         count = 0;                      /* init count to zero                   */
175
176
177
178         switch(opcode)
179         {
180
181             case AND:
182                 maxc = maxa < maxb ? maxa : maxb;
183
184                 for(j = 0; j <= maxc; j++)
185                 {
186                     if( *checkptr++ == (MASKA | MASKB) )
187                     {
188
189                         *listptr++ = j;
190                         count++;
191                         if(listptr >= endlist)
192                             write(fidc,(listptr = list),(endlist - list) * 2);
193                     }
194                 }
195             break;                      /* end case AND                         */
196
197             case OR:
198                 maxc = maxa > maxb ? maxa : maxb;
199
200                 for(j = 0; j <= maxc; j++)
201                 {
202                     if( *checkptr++ != 0 )
203                     {
204
205                         *listptr++ = j;
206                         count++;
207                         if(listptr >= endlist)
208                             write(fidc,(listptr = list),(endlist - list) * 2);
209                     }
210                 }
211             break;                      /* end case OR                          */
212
213             case EXCEPT:
214                 maxc = maxa;
215
216                 for(j = 0; j <= maxc; j++)
217                 {
218                     /****** if a and not b  */
219
220                     if( (*checkptr & MASKA)  &&  !(*checkptr & MASKB) )
221                     {
222
223                         *listptr++ = j;
224                         count++;
```

```
225                         if(listptr >= endlist)
226                             write(fidc,(listptr = list),(endlist - list) * 2);
227                     }
228                     checkptr++;
229                 }
230             break;                  /* end case EXCEPT                      */
231
232         }
233
234
235
236         /****** terminate list and write out the remainder  */
237
238         *listptr++ = -1;
239
240         write(fidc, list, (listptr - list) * 2);
241
242         return(count);
243     }
```

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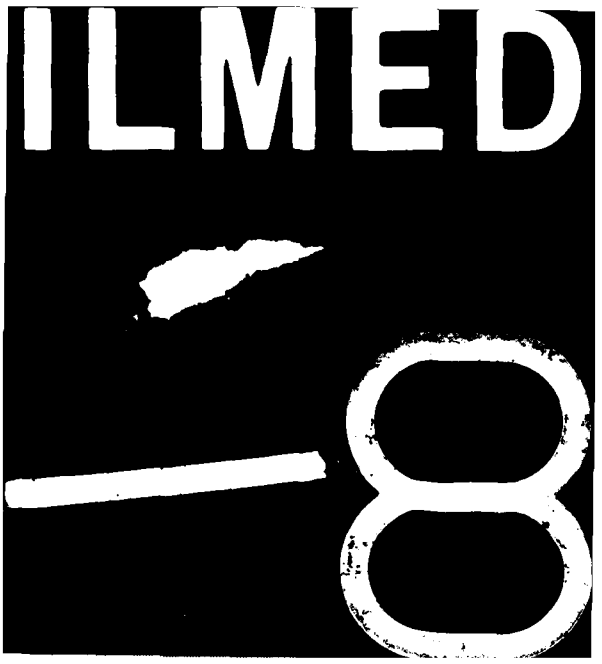
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